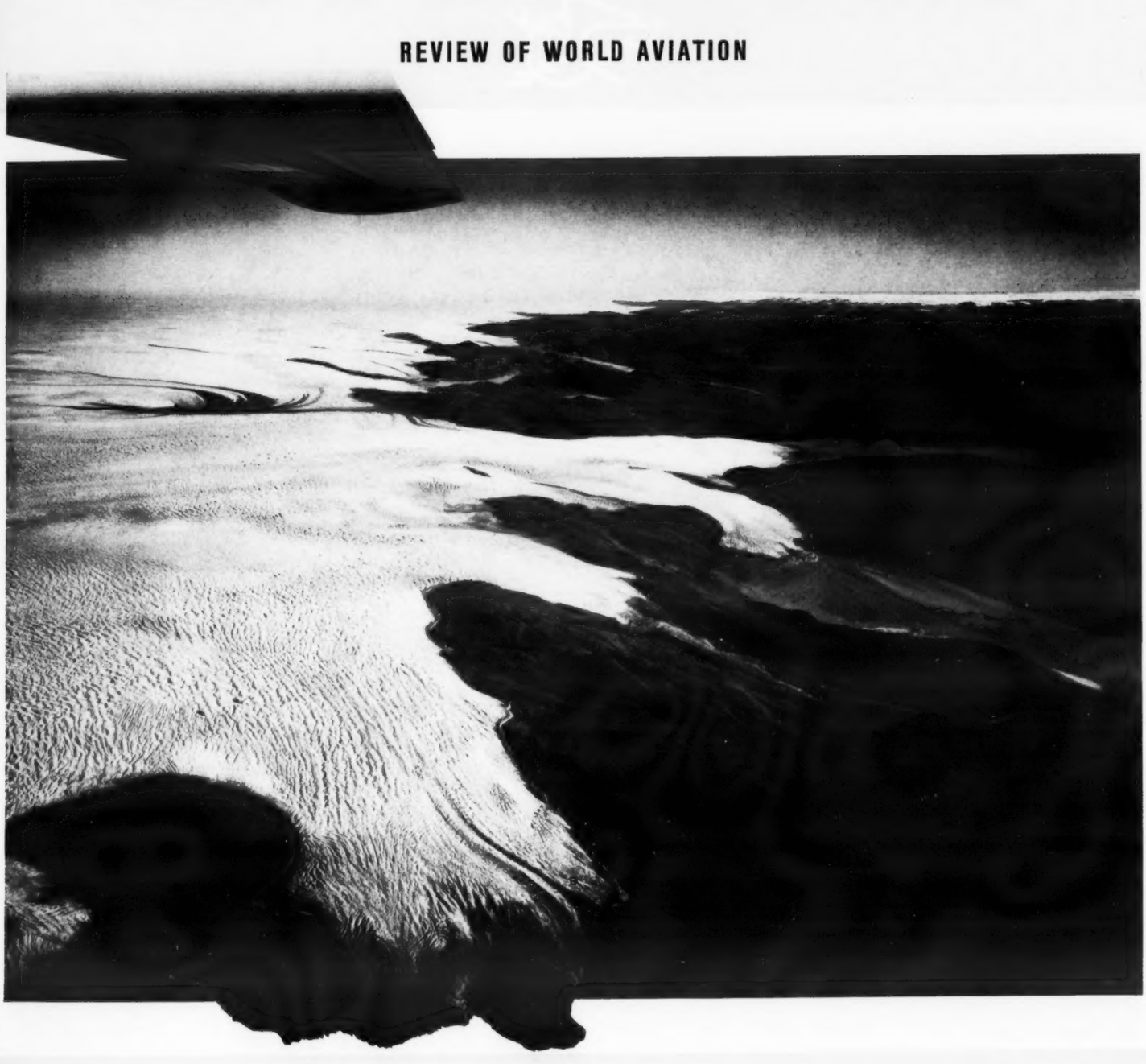
INTERAVIA

REVIEW OF WORLD AVIATION



Price of this Issue

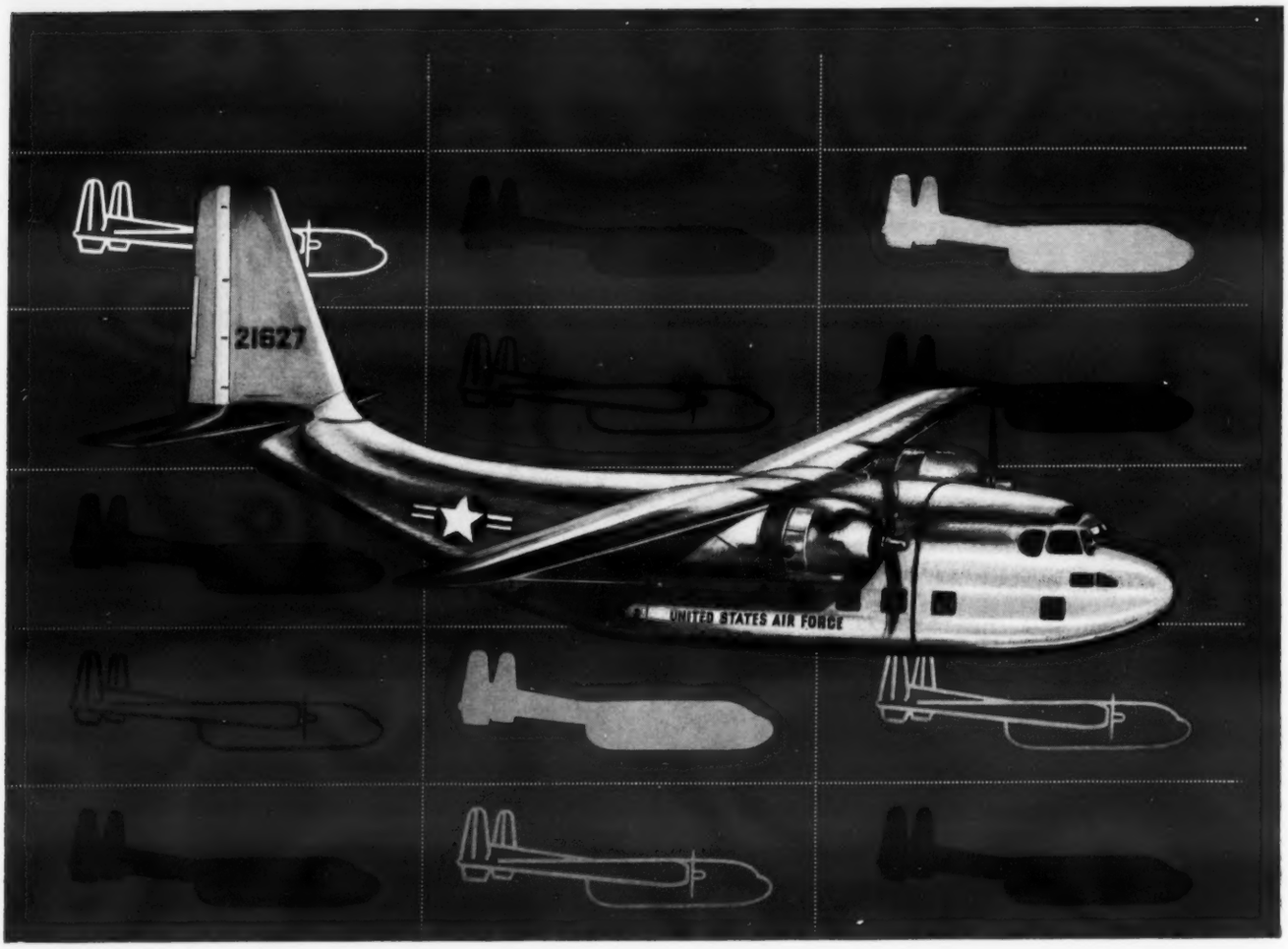
U.S.A.:	80 cents
British Isles:	3 s
Switzerland:	Fr. 2.80
Netherlands:	Fl. 2.50
Denmark:	Cr. 5.-
Germany:	DM 2.75
France:	Fr. 250
Italy:	Lire 410
Japan:	U.S.$ 0.80
Sweden:	Cr. 3.50

IN THIS ISSUE

"Ice Water Imperialism"

Polar Crossroads

VOLUME X 2 1955



FLYING BOXCAR AND AVITRUC TEAMED FOR MILITARY AIR TRANSPORTATION!

Close to full-scale production at Fairchild — the new C-123 Assault Transport will fill specialized military requirements for an air transport sufficiently versatile to deliver men or equipment at advanced bases. This sturdy craft readily converts from a carrier of 60 fully equipped combat troops to a cargo plane delivering more than 15 tons of equipment.

Continuing quantity production of the combat proven C-119 Flying Boxcar assures the nation that our military transport program is completely flexible. This dual production brings closer the day when C-119's and C-123's will be in regular use as a part of the U. S. Air Force and U. S. Army military operations.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

American Helicopter Division, Manhattan Beach, Calif.
Engine Division, Farmingdale, N.Y. • Guided Missiles Division, Wyandanch, N.Y.
Kinetics Division, New York, N.Y.
Speed Control Division, Lt. Augustine, Fla. • Stratos Division, Bay Shore, N.Y.

INTERAVIA

Review of World Aviation

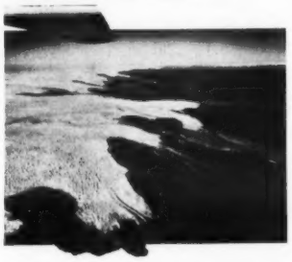
Volume X | No. 2 | 1955

Editor : E. E. Heiman
Executive Editors : P. A. Blackburn, E. Herzfeld, H. Rieck
Associate Editors : J. M. Stroud, E. Baur, H. Lapierre, Ginés de Bracamonte, F. Sanabria
Art Editor : H. W. Mahrer
Layout Adviser : K. Keller
Circulation Manager : G. Deneke

Contents

POLAR CROSSROADS

"Ice Water Imperialism"		87
The Importance of Arctic Flying	B. BALCHEN, WASHINGTON	88
By Arild Viking to the New World		90
Mounting Guard at the Pole		98
Rescue and Supply Work by Air in Greenland	R. POMMIER, PARIS	107
Brief History of Polar Flying	C. DOLLFUS, PARIS	110
Air Navigation in the Arctic		112
From the Solar Column to the Universal Time Clock	L. M. LOSKE, ZURICH	116
Radar Installations at Zurich-Kloten		118
Radar and Television at Orly Airport	E. GUIGONIS, PARIS	120
What's in the Air ?		121
The First European Aeronautical Congress		123
Equipment Round-Up		124
Thirty Years of Celestial Navigation	A. BASTIDE, PARIS	126
Book Reviews		128
The Mind of Mr. Reader		130



Front cover :

Air lanes in the Arctis: an aircraft of Scandinavian Airlines System approaches the Greenland Icecap.

Appears Monthly in Four Editions : English, French, Spanish and German.

Advertising Department : Publishing and Editorial Offices, Subscription Department : Interavia S. A., 6, Corraterie, Geneva. Cables and Telegrams : Interavia-Geneva. Teleprinter : 2 21 22. Postal Cheque Account : Geneva I 5380.

New telephone number: 25 42 34 (five lines)

Annual Subscriptions : U.S.A. and Canada, $7.00 ; United Kingdom and Eire, £1.15.0 ; Commonwealth, £2.6.0 ; Switzerland, 28.— fr. ; Austria, 170.— sch. ; Belgium, 320.— fr. ; Brazil, 230.— Cr$. ; Denmark, 48.- Kr. ; France, fr. 2400.— ; Germany 27.50 DM ; Holland, 25.— fl. ; Japan, $7.00 ; Norway, 50.— kr. ; Spain, 280.— ptas. ; Sweden, 35.— kr. ; Uruguay, 23.— pesos. All other countries, 28.— Sw. fr.

AGENTS :

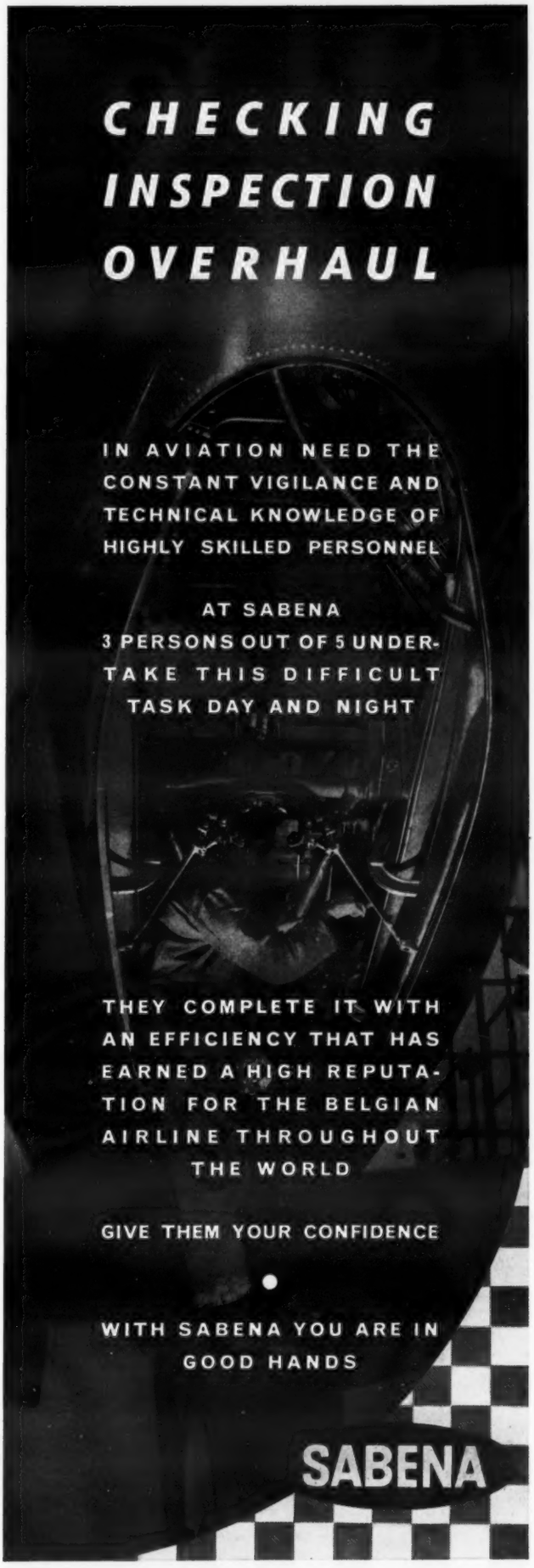
Interavia Austria	Postfach 162, Vienna I
Interavia Belgium	5, Heidestraat Noord, Capellenbosch-lez-Anvers
Interavia Canada	21, Hargrove Lane, Toronto 14, Ont.
Interavia France	144, Avenue des Champs-Elysées, Paris 8me
Interavia Germany	Interavia Verlags G.m.b.H., Friedrich Ebert-Strasse 1, Frankfurt/M
Interavia Great Britain	27, Old Bond Street, London, W.1
Interavia Holland	Henk A. Jansen, Olympiaplein 84, Amsterdam-Z
Interavia Italy	30, Via San Marino, Rome 7.23
Interavia Japan	Isogo P.O. Box 3, Yokohama
Interavia South Africa	P.O. Box 6073, Johannesburg
Interavia Spain	Donoso Cortés 85, Madrid
Interavia Sweden	P.O. Box 29, Linköping
Interavia U.S.A.	Head Office: 123 N. Gladys Ave., Monterey Park, Calif. Branch Office: 185 Madison Ave., New York 16, N.Y.

DISTRIBUTORS :

Canada	Wm. Dawson Subscription Service Ltd., 587 Mount Pleasant Road, Toronto, 12, Ont. Edward Company Regd., 4720 Ridgevale Avenue, Montreal 26, P. Q.
Czechoslovakia	Artia S. A., Smecky 30, Praha II
Denmark	Dansk Centralagentur, Stormgade 20, Copenhagen
Finland	Akateeminen Kirjakauppa, Keskuskatu 2, Helsinki Rautatiekirjakauppa Oy, Köjdenpunojank 2, Helsinki
Germany	W. E. Saarbach, Gereonstr. 25-29, Cologne
Great Britain	W. H. Smith & Son, Ltd., Strand House, Portugal Street, London, W.C. 2 Wymans Ltd., New Street Square, London, E.C. 4.
Hungary	Kultura, Akademia-utca 10, Budapest V
Ireland	Basil Clancy, Esq., Cooleevin, Foxrock, Co. Dublin
Israel	F. Pinczower, P.O. Box 6008, Tel Aviv
Japan	Maruzen Co. Ltd., 6 Tori-Nichome Nihonbashi, Tokyo
Norway	Narvesens Kioskkompani A. S., Box 125, Oslo
Uruguay	Humanitas, Colonia 883, Montevideo

Copyright 1955 by Interavia S. A., Geneva, Switzerland

Printed in Switzerland
Imprimerie de « La Tribune de Genève », Geneva
AG. Fachschriften-Verlag und Buchdruckerei, Zurich


CHECKING
INSPECTION
OVERHAUL
IN AVIATION NEED THE CONSTANT VIGILANCE AND TECHNICAL KNOWLEDGE OF HIGHLY SKILLED PERSONNEL
AT SABENA
3 PERSONS OUT OF 5 UNDERTAKE THIS DIFFICULT TASK DAY AND NIGHT
THEY COMPLETE IT WITH AN EFFICIENCY THAT HAS EARNED A HIGH REPUTATION FOR THE BELGIAN AIRLINE THROUGHOUT THE WORLD
GIVE THEM YOUR CONFIDENCE
WITH SABENA YOU ARE IN GOOD HANDS
SABENA

United Airgram

UNITED AIRCRAFT EXPORT CORPORATION

38th COLLIER TROPHY AWARDED FOR TWO J-57-POWERED JET FIGHTERS

The Collier Trophy, America's highest annual award for achievement in aviation, was awarded jointly in mid-December to the men who directed development of America's first two supersonic jet fighters, both of which are powered by Pratt & Whitney Aircraft J-57 turbojet engines and afterburners. Receiving the trophy were J.H. Kindelberger, chairman of the board and chief executive officer of North American Aviation, for the Air Force F-100 Super Sabre, and Edward H. Heinemann, chief engineer of Douglas Aircraft Company's El Segundo Division, for the Navy F4D Skyray.

First U.S. production airplane to fly supersonically in level or climbing flight was the F-100. This plane holds the present official world's speed record of 755.149 miles per hour. Deliveries from North American's production line at Los Angeles began more than a year ago. Today the big fighter is being introduced into operational Air Force units.

The F-100 is 45 feet long, 14 feet high, and has a wing span of 36 feet. The wings and tail are swept back 45 degrees. It has a service ceiling of above 50,000 feet and a combat radius of over 500 nautical miles. Flight tests began in May, 1953, and production deliveries started in October of that year.

Second of the prize-winning pair of supersonic fighters is the Douglas F4D, a single-engine Navy fighter which is expected to be in carrier service this year. It is an interceptor. With its J-57 engine, the production model promises higher all-around performance than the prototype F4D that set a briefly-held world speed record of 753.4 miles per hour in October, 1953.

Like the F-100, the F4D is large for a fighter. It is 50 feet long. Span of its unique, modified delta wing is 33½ feet. The Skyray is now in quantity production in California at Douglas Aircraft Company's El Segundo division.

A year ago, the 38th Collier Trophy was awarded for the development of the Pratt & Whitney Aircraft J-57 turbojet. This 10,000-pound-thrust power plant provides outstanding performance in a number of other U.S. fighters, bombers and one tanker-transport, as well as F-100s and F4Ds.

HAMILTON STANDARD ADVANCES IN THE AIRCRAFT EQUIPMENT FIELD

Hamilton Standard, long the leader in the design and manufacture of propellers, is rapidly advancing to a position of leadership in the aircraft equipment field. Today the company produces over 90 items of equipment, exclusive of propellers and propeller controls. Included are air-conditioning systems and components, fuel controls, pneumatic valves, jet engine starters, hydraulic pumps and temperature controls. Models of these basic products are manufactured for 58 jet aircraft installations.

Hamilton Standard's propeller activity continues at a high level in spite of the company's growing work with aircraft equipment. Ten different propeller types are being made today for 24 different piston or turboprop-powered aircraft now in production. Included are 15-foot Turbo-Hydromatic propellers for use on a new turboprop military transport.

The last few years have been marked by the continuing expansion of research, test and development facilities at the company's plant in Windsor Locks, Connecticut. These facilities reflect the growing demands imposed on modern aircraft by widely different operating and climatic conditions.

NEW HELICOPTER ALTITUDE RECORD SET BY SIKORSKY

With a flight to 24,500 feet, Sikorsky Aircraft's new XH-39 has established a new altitude record for helicopters. The flight was made at Bridgeport, Connecticut, on October 17. It topped the old mark, set in 1953, by 2390 feet.

Both altitude and speed records are now held by Sikorsky's new utility helicopter, which was built for the U.S. Army. The turbine-powered aircraft whirled to a record speed of 156.005 miles per hour late last summer. Pilot on both flights was the Army's Warrant Officer Billy Wester.

The XH-39 is a spirited performer. It is powered by one Turbomeca Artouste II, a light-weight gas turbine engine developing about 400 horsepower. The engine is being made in the U. S. under license and is known as the Continental T-51. The XH-39, first helicopter to have fully retractable landing gear, is capable of carrying three passengers plus cargo, or a total payload of 800 pounds in the 81-cubic-foot cabin compartment.

The XH-39 is the first Sikorsky helicopter development to be powered by a turbine engine.

UNITED AIRCRAFT EXPORT CORPORATION . . . . . EAST HARTFORD 8, CONN., U.S.A.
European Offices: 3/5 Warwick House Street, London SW1, England

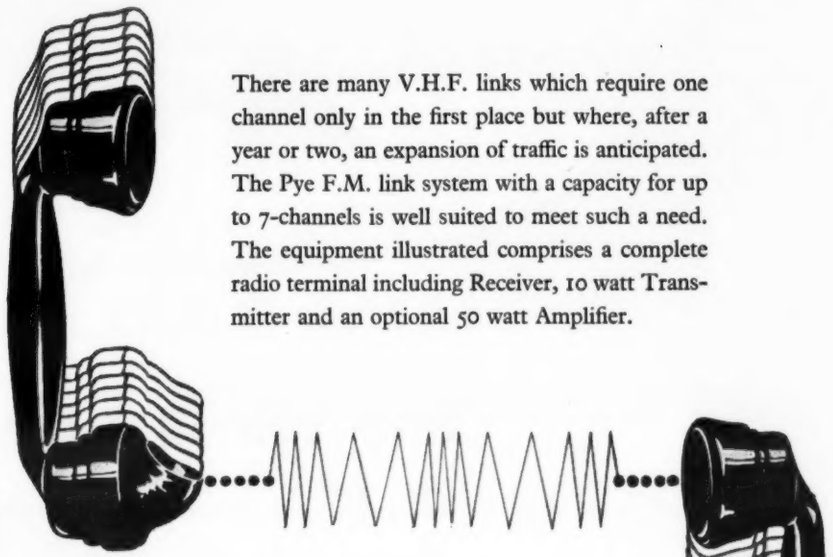
AVIONS HUREL-DUBOIS

VERRIÈRES-MEUDON ROAD, VILLACOUBLAY - FRANCE

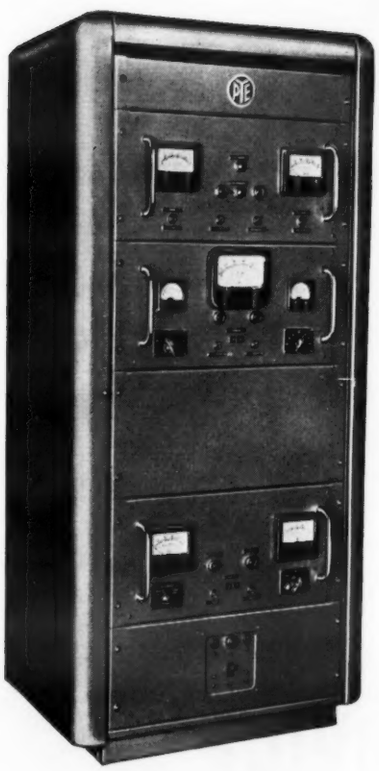
POST BOX No. 6, MEUDON - TEL.: OBS. 27-90

POINT-TO-POINT FM V.H.F.

RADIO TELEPHONE LINK



There are many V.H.F. links which require one channel only in the first place but where, after a year or two, an expansion of traffic is anticipated. The Pye F.M. link system with a capacity for up to 7-channels is well suited to meet such a need. The equipment illustrated comprises a complete radio terminal including Receiver, 10 watt Transmitter and an optional 50 watt Amplifier.



Abbreviated Specification

Frequency range 60—216 mc/s

Transmitter output Power
10 watts, or with Amplifier Unit—
50 watts

Maximum Deviation 50 kc/s

Overall Transmitter-Receiver Performance

Frequency Response
300 c/s—6 kc/s ± 3 db
6 kc/s—36 kc/s ± 1 db

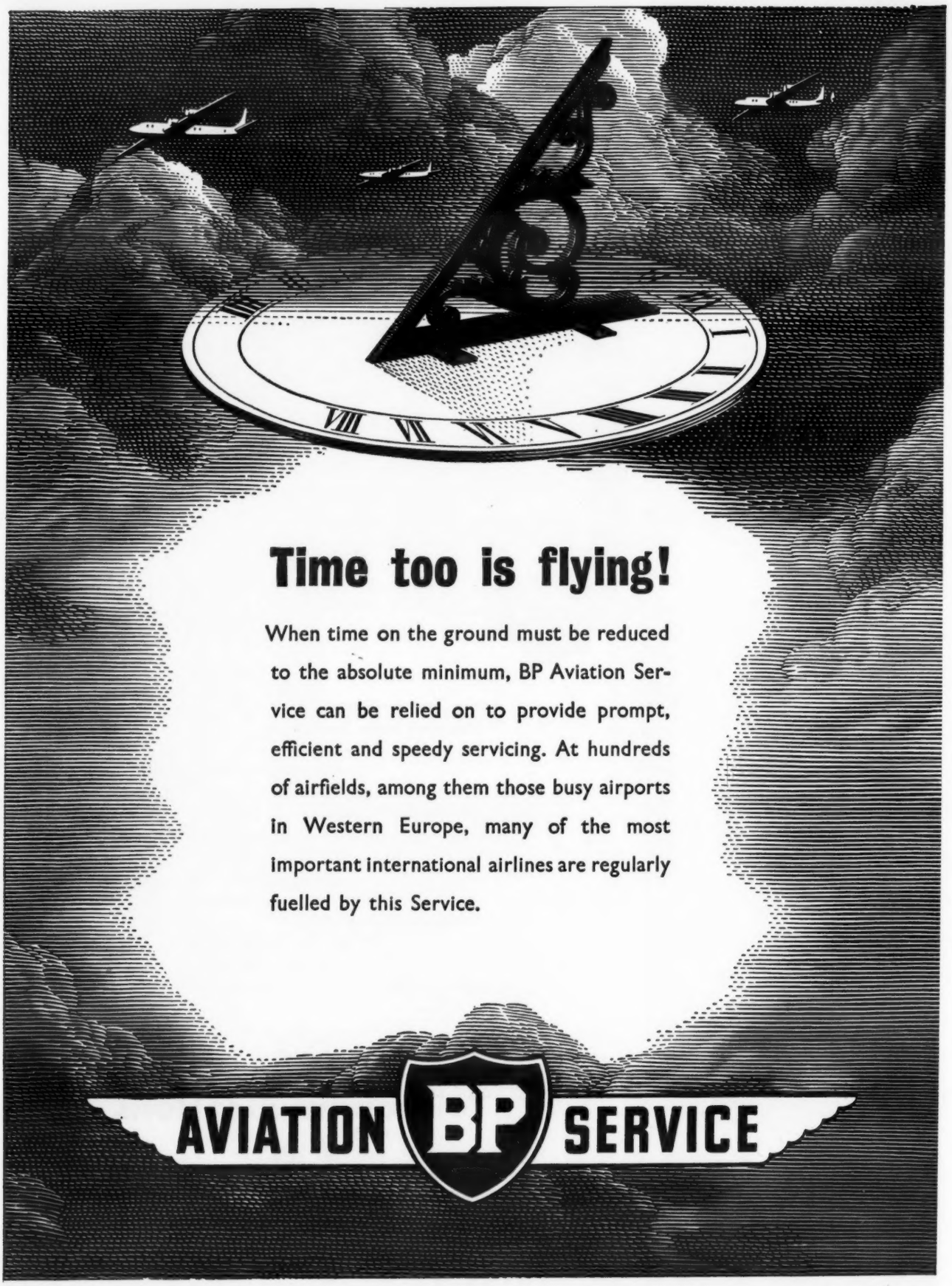
Intermodulation Level
At least—55 dbm for 2 tones
applied each at 0 dbm

Receiver Bandwidth 6 db down ± 120 kc/s

Telecommunications
CAMBRIDGE ENGLAND

Pye New Zealand Ltd. Aûckland C.I., New Zealand	Pye Canada Ltd. Ajax, Canada	Pye-Electronic Pty., Ltd. Melbourne, Australia	Pye Ireland, Ltd. Dublin, Eire
Pye Radio & Television (Pty.) Ltd. Johannesburg South Africa	Pye Limited Plaza de Necaxa 7 Mexico 5	Pye Limited Tucuman 829 Buenos Aires	Pye Limited 5th Avenue Building 200, 5th Avenue, New York

PYE LIMITED . . CAMBRIDGE . . ENGLAND



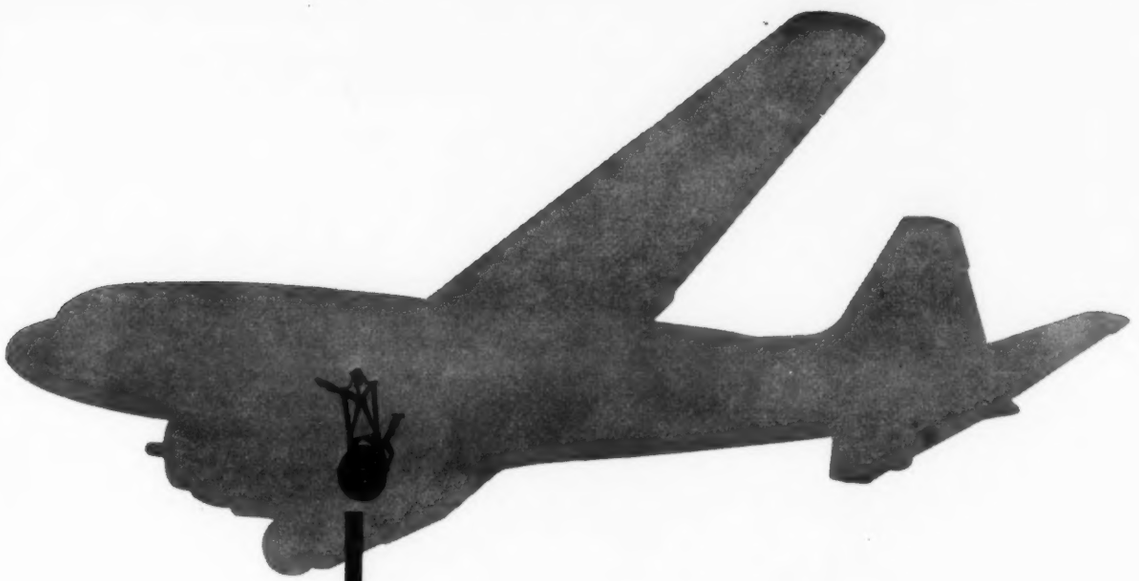
Time too is flying!

When time on the ground must be reduced to the absolute minimum, BP Aviation Service can be relied on to provide prompt, efficient and speedy servicing. At hundreds of airfields, among them those busy airports in Western Europe, many of the most important international airlines are regularly fuelled by this Service.

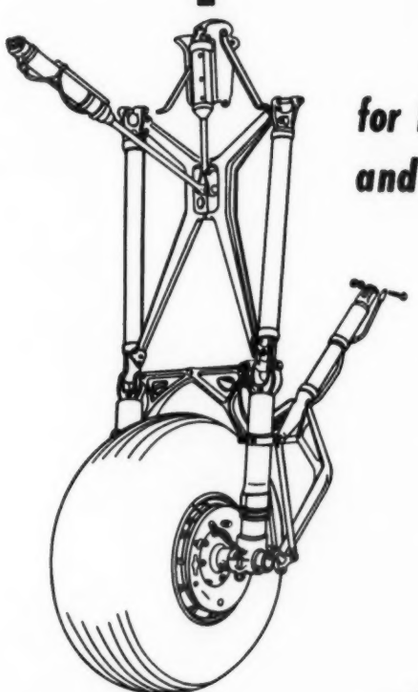
AVIATION BP SERVICE

THE BRITISH PETROLEUM COMPANY LIMITED.

(Previously Anglo-Iranian Oil Company, Limited.)



DOUGLAS HAS MILLIONS OF SPARE PARTS IN STOCK



for DC-3s (C-47s), DC-4s (C-54s) and DC-6s (6As and 6Bs)

Douglas is still manufacturing spare parts for all the above models, including the DC-3. If you want to be sure of getting the spare parts you need on time, order them from Douglas.

WRITE TODAY for the helpful and informative Douglas Spare Parts Booklet.

Douglas Parts Sales Division
Douglas Aircraft Company, Inc.
Santa Monica, California, U.S.A.
Cable DOUGLASAIR

Depend on DOUGLAS

Genuine Spare Parts

TAKE YOUR NEXT EUROPEAN TRIP BY

VICKERS VISCOUNT

THE AIRCRAFT APPRECIATED BY THE EXPERTS

Air France has just equipped its main European services with the modern aircraft best suited to medium-stage routes, the Vickers "Viscount". With its four Rolls-Royce "Dart" turboprops, the "Viscount" has a cruising speed of 320 m.p.h. at 25,000 ft.

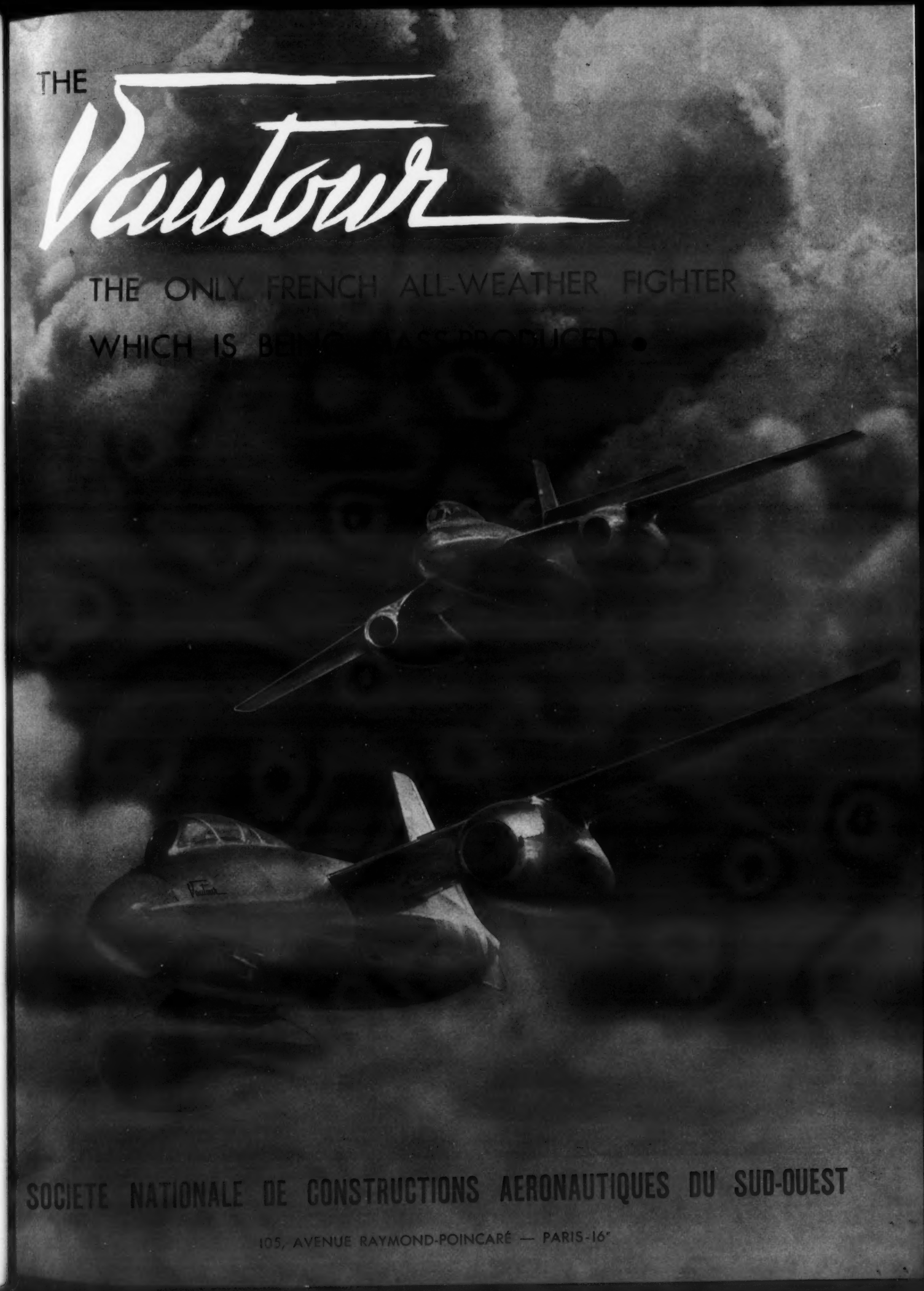
For the pilot it is the most "docile" of aircraft, for the passenger the most comfortable. No more noise on board, no vibration, a maximum of air volume, a maximum of visibility. Fully sound-proofed and pressurized, the cabin is 40 ft. long and nearly 10 ft. wide, with big windows giving passengers a wide view outside.

Air France "Viscounts" operate services every day to:
London, Hamburg, Stockholm, Geneva.
Every weekday to Rome.
Four times a week to Copenhagen.
Three times a week to Vienna, Munich, Milan.
All these services, except the special "Epicurien" service to London, are tourist class.

Air France serves 35 cities in Europe. Its network is the longest in the world, with 230 points of call in 72 countries and five continents.

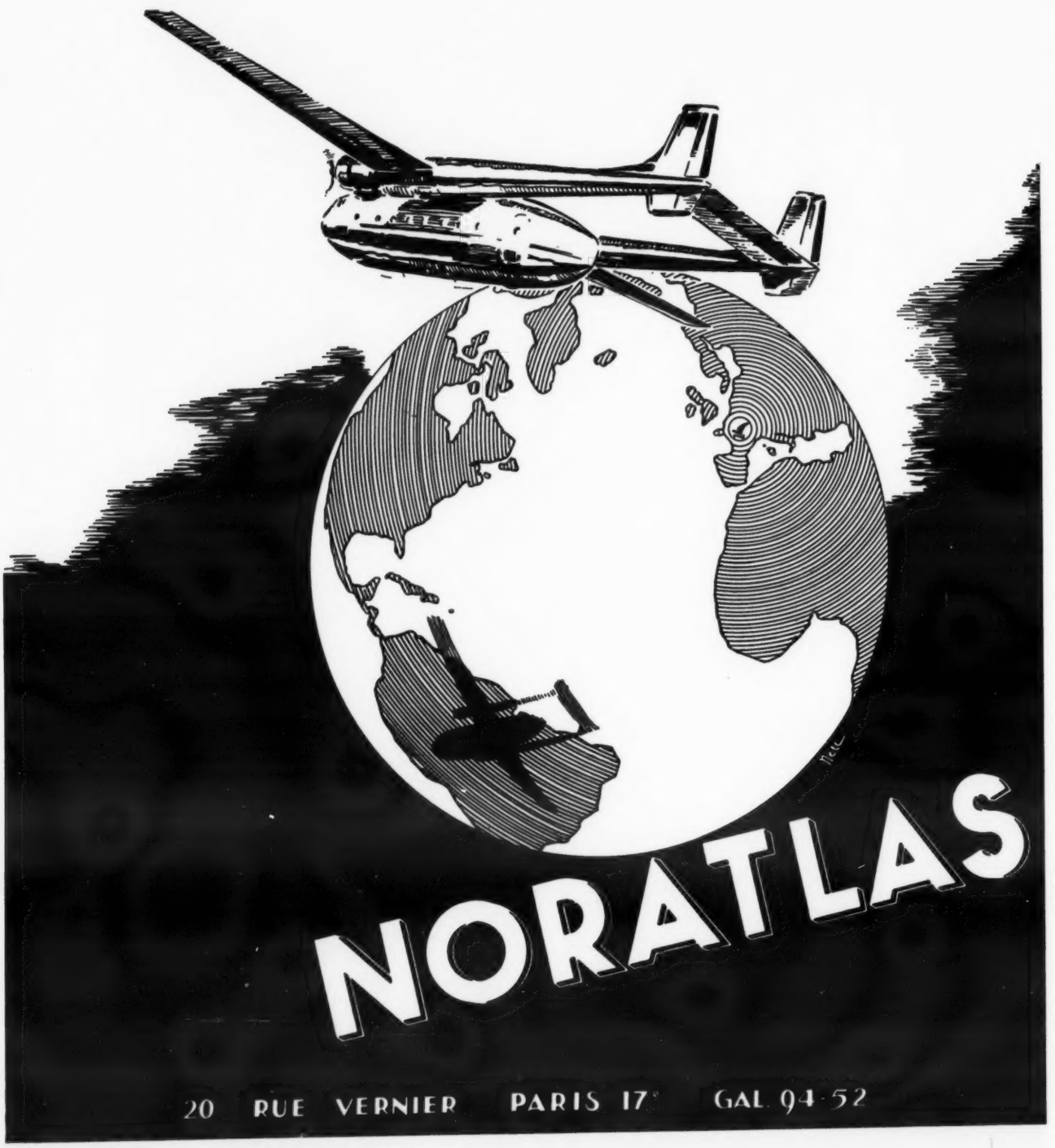
AIR FRANCE *35 years experience at your service*

INFORMATION FROM TRAVEL AGENCIES OR AIR FRANCE OFFICES IN PARIS, LYONS, STRASBOURG, NANTES, BORDEAUX, MARSEILLES, TOULOUSE AND NICE

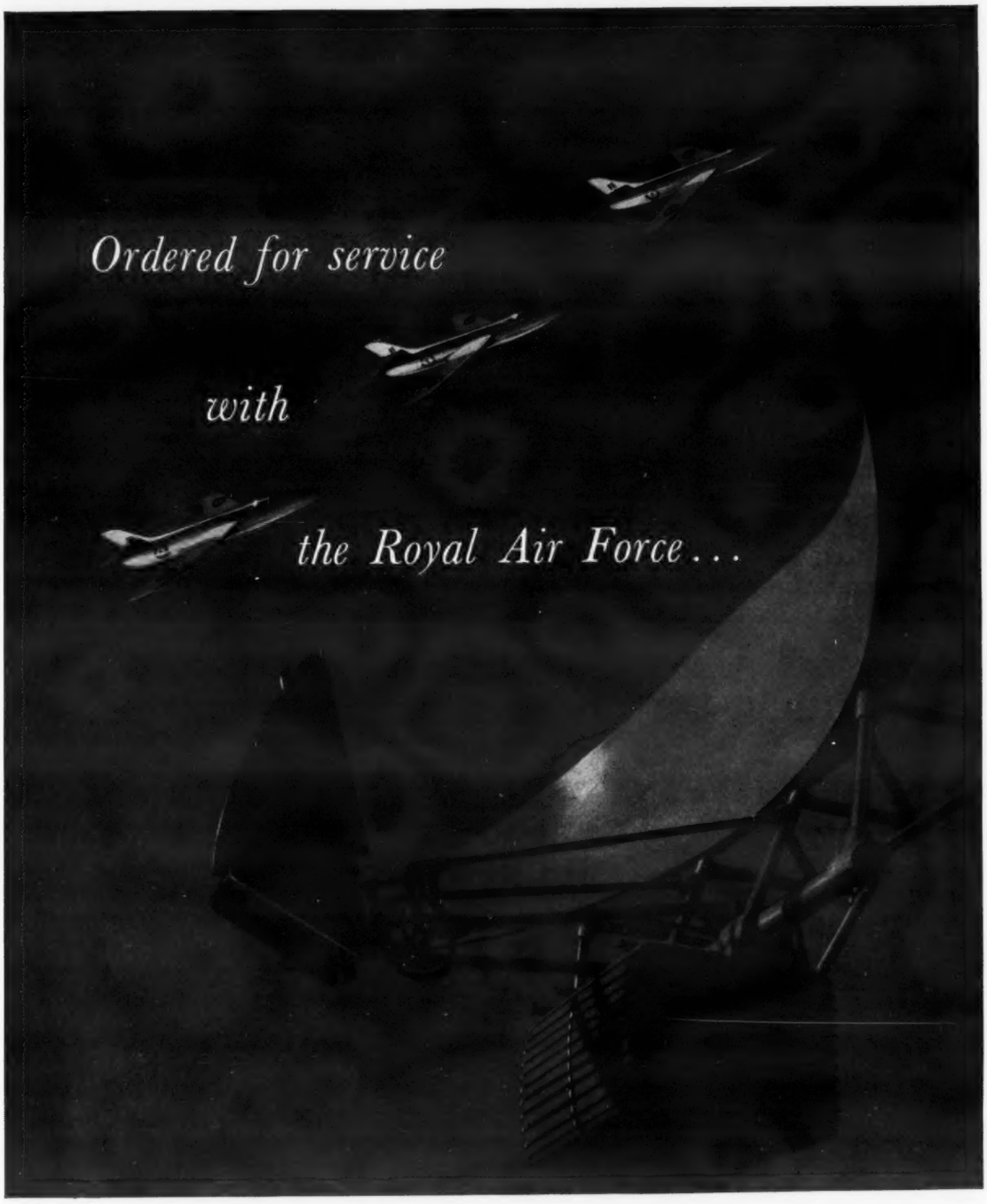

THE
Vautour
THE ONLY FRENCH ALL-WEATHER FIGHTER
WHICH IS BEING MASS PRODUCED
SOCIETE NATIONALE DE CONSTRUCTIONS AERONAUTIQUES DU SUD-OUEST
105, AVENUE RAYMOND-POINCARÉ — PARIS-16e

SNCAN

NORD 2501



20 RUE VERNIER PARIS 17e GAL 94-52



Now in full production for early delivery in static, mobile or air transportable versions.

DECCA 424 Radar

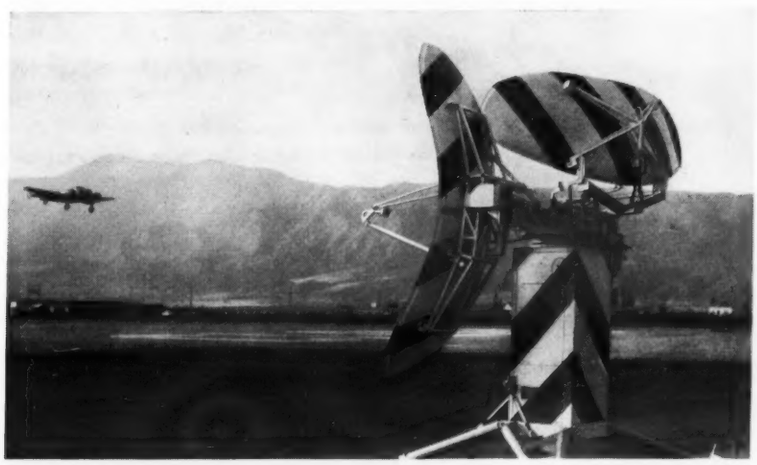
DECCA RADAR LIMITED, 1-3 BRIXTON ROAD, LONDON, S.W. 9

The
only
European
aircraft
with
supersonic speed
in LEVEL FLIGHT
ordered
in
quantity:

Mystère IV B2

AVIATION EXPERTS FROM AROUND THE WORLD SEE GILFILLAN GCA QUADRADAR DEMONSTRATED

Representatives of the Royal Canadian Air Force, the Royal Australian Air Force and the United States Air Force were among the many groups attending the field demonstrations of the new Gilfillan GCA Quadradar during November-December, 1954. Also witnessing the performance of the perfected equipment during this period were authorities from the French Air Force; the Spanish Air Force; the International Civil Aviation Organization, representing 63 countries; all Commands of the United States Air Force; United States Navy BuShips, BuAer and CNO; and the Civil Aeronautics Administration.



Over 200 aviation authorities attending the recent field tests agree the Gilfillan GCA Quadradar more than fulfills advance predictions of remarkable versatility. Arousing most comment was the clear demonstration that the new 4-in-1 equipment enables a single operator to handle multiple aircraft in a complex traffic pattern including emergency landings. Favorable comment also included the greatly increased definition and expansion of the precision approach display afforded by the new Beta Scan Azel scope developed by Gilfillan; instant rotation of antennas to serve desired runway remoted to operator's position; built-in circular polarization, eliminating rain and snow clutter; and, with the height-finding display, the location and checking of jet aircraft at 47,000 feet. The United States Air Force is now completing evaluation tests of the new equipment.

IN PRODUCTION. *Delivery:* 10 Months from Date of Order

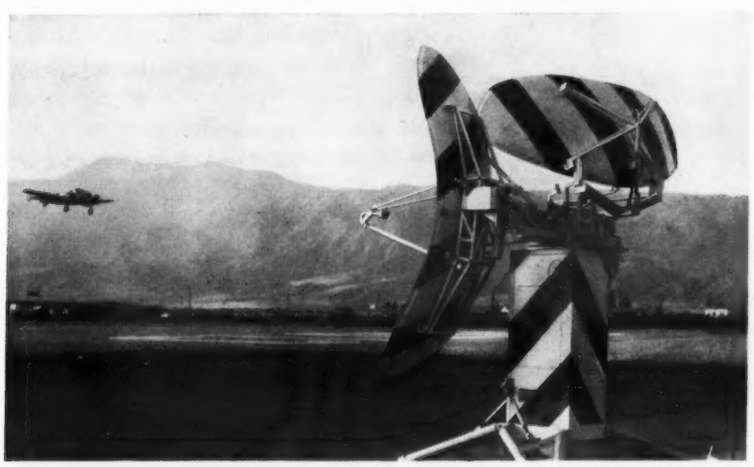
GCA RADAR AND ELECTRONICS
Gilfillan
LOS ANGELES
AROUND THE WORLD

The
only
European
aircraft
with
supersonic speed
in LEVEL FLIGHT
ordered
in
quantity:

Mystère IVB2

AVIATION EXPERTS FROM AROUND THE WORLD SEE GILFILLAN GCA QUADRADAR DEMONSTRATED

Representatives of the Royal Canadian Air Force, the Royal Australian Air Force and the United States Air Force were among the many groups attending the field demonstrations of the new Gilfillan GCA Quadradar during November-December, 1954. Also witnessing the performance of the perfected equipment during this period were authorities from the French Air Force; the Spanish Air Force; the International Civil Aviation Organization, representing 63 countries; all Commands of the United States Air Force; United States Navy BuShips, BuAer and CNO; and the Civil Aeronautics Administration.



IN PRODUCTION. *Delivery:* 10 Months from Date of Order

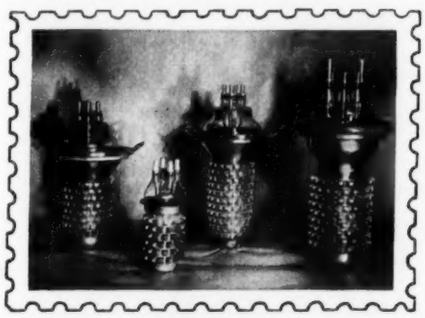
Over 200 aviation authorities attending the recent field tests agree the Gilfillan GCA Quadradar more than fulfills advance predictions of remarkable versatility. Arousing most comment was the clear demonstration that the new 4-in-1 equipment enables a single operator to handle multiple aircraft in a complex traffic pattern including emergency landings. Favorable comment also included the greatly increased definition and expansion of the precision approach display afforded by the new Beta Scan Azel scope developed by Gilfillan; instant rotation of antennas to serve desired runway remoted to operator's position; built-in circular polarization, eliminating rain and snow clutter; and, with the height-finding display, the location and checking of jet aircraft at 47,000 feet. The United States Air Force is now completing evaluation tests of the new equipment.

GCA RADAR AND ELECTRONICS
Gilfillan
LOS ANGELES
AROUND THE WORLD

Cie FRANÇAISE THOMSON-HOUSTON

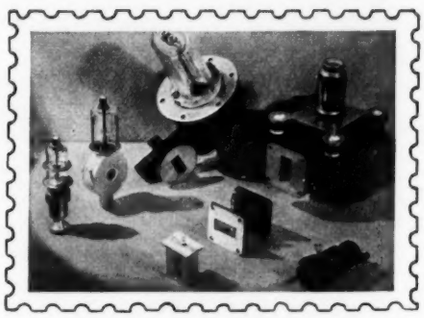
IN THE FRONT RANK OF EUROPEAN

ELECTRONIC MANUFACTURERS



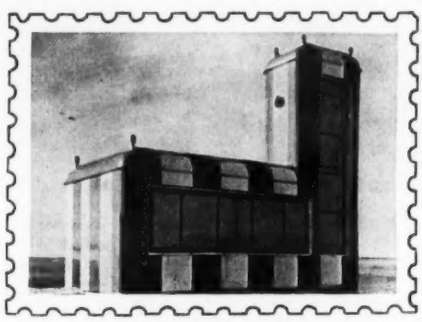
VAPOTRONS

CFTH



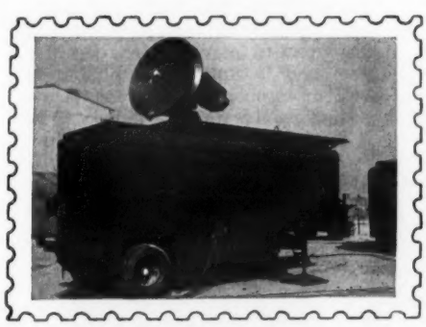
VHF TUBES

PORTABLE TRANSMITTER-RECEIVERS



G.C.A. EQUIPMENT

RADIO-COMMUNICATIONS



AUTOMATIC RADAR

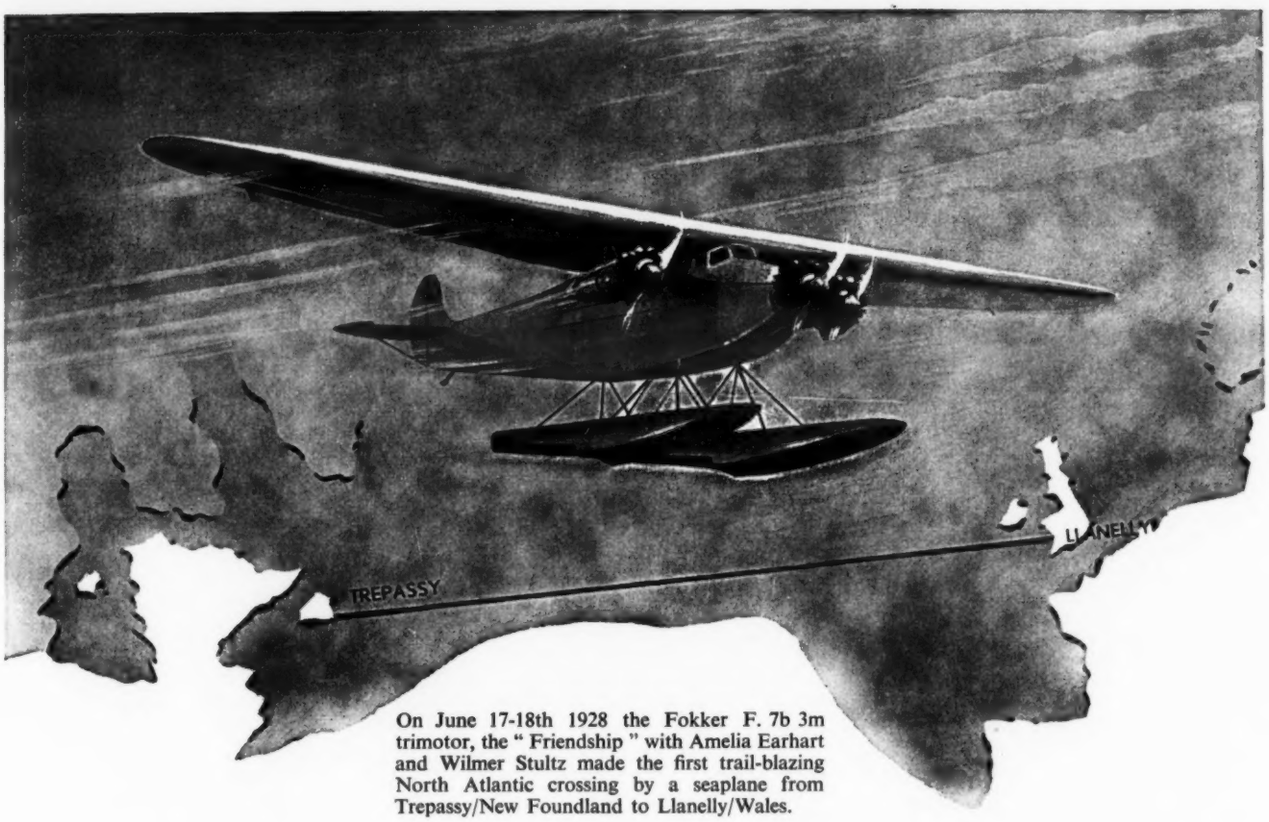
High-power
RADAR

MARINE RADAR

COMPAGNIE FRANÇAISE THOMSON-HOUSTON

GROUPE ÉLECTRONIQUE

173 Bd Haussmann Paris (8) Tél. ELYsées 83.70 Télégr. ELIHU-42-Paris



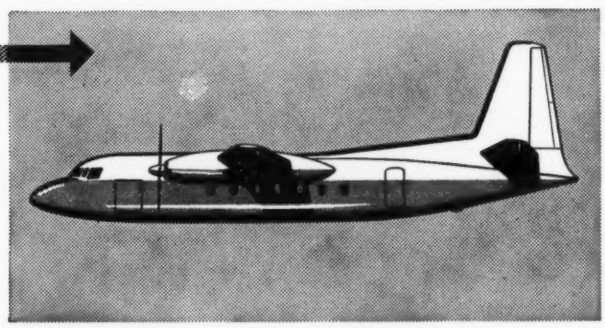
On June 17-18th 1928 the Fokker F. 7b 3m trimotor, the " Friendship " with Amelia Earhart and Wilmer Stultz made the first trail-blazing North Atlantic crossing by a seaplane from Trepassy/New Foundland to Llanelly/Wales.

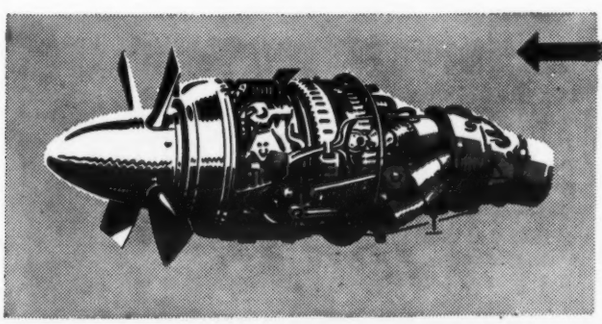
PIONEERS IN THE PAST — Fokker — PIONEERS IN THE FUTURE

FOKKER WILL SPAN THE WORLD AGAIN!

THE NEW FOKKER F. 27 "FRIENDSHIP"

twin-turboprop airliner for 28-36 passengers in which more than 35 years of experience in commercial aviation is incorporated, is the most suitable transport for short to medium range traffic available, meeting both ICAO and CAR 4b requirements.





THE ROLLS-ROYCE "DART" TURBOPROPS

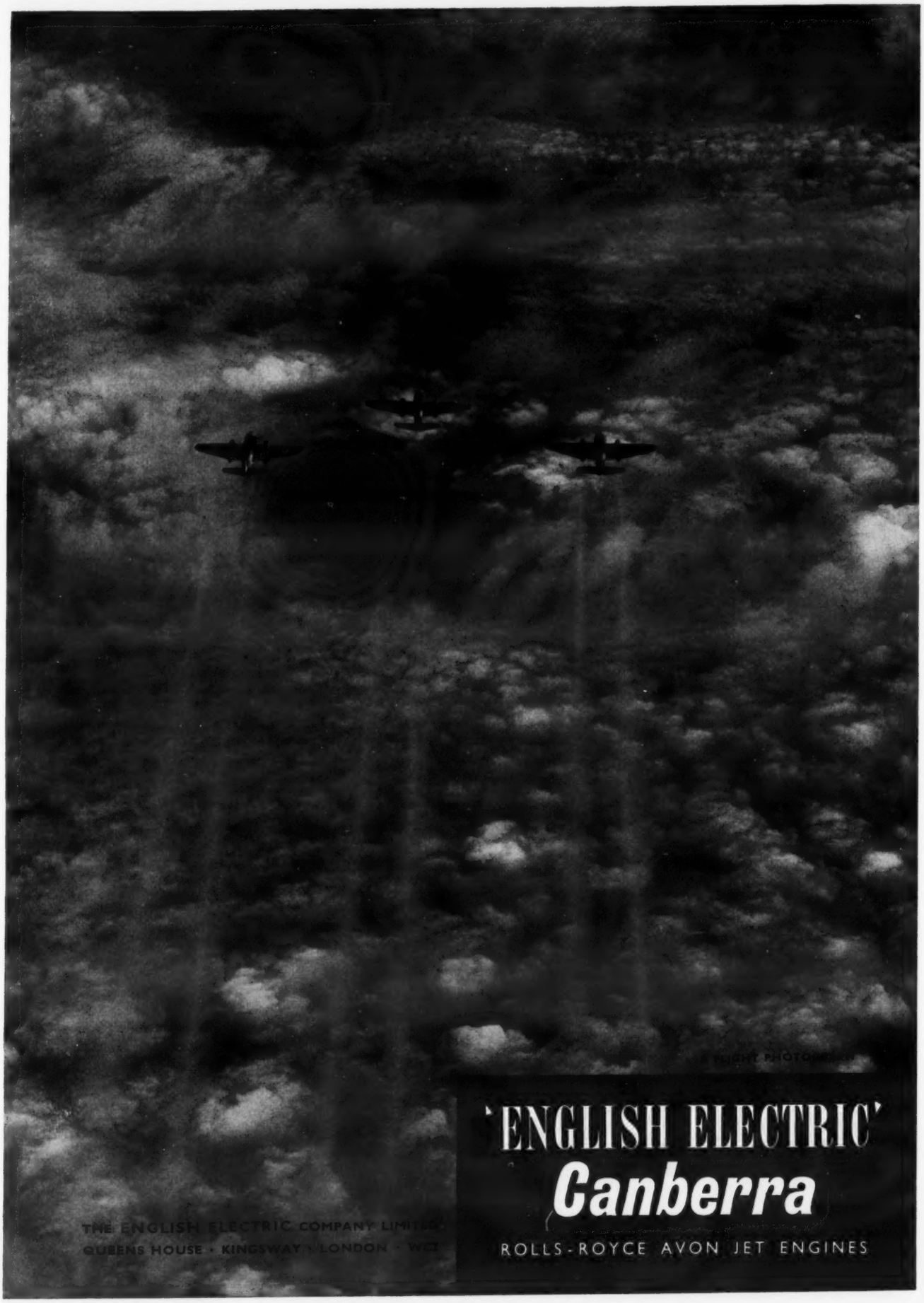
with which the " Friendship " is powered are the most reliable propeller-turbines available for this type of aircraft. They allow economical operation in all climates and safe and vibrationless flight at 20,000 ft.

* * *

ROYAL NETHERLANDS AIRCRAFT FACTORIES FOKKER

SCHIPHOL-ZUID

TEL. ADDR.: FOKPLANES-AMSTERDAM


'ENGLISH ELECTRIC'
Canberra
ROLLS-ROYCE AVON JET ENGINES
THE ENGLISH ELECTRIC COMPANY LIMITED
QUEENS HOUSE · KINGSWAY · LONDON · WC2

INTERAVIA

Deadline Notes

No. 2 1955

C.P.A.L. POLAR ROUTE APPROVED

Canadian Pacific Air Lines' application for permission to operate a trans-Polar route from Vancouver to Amsterdam has been approved by the Canadian Government. The company plans to open the service early in May, with one flight weekly in each direction. A mixed-class (first class and tourist) Douglas DC-6B will leave Vancouver every Friday and Amsterdam on Saturdays. Flying time 18 hours 30 minutes. Refuelling stops will be made at Churchill, Manitoba, on the eastbound flight, and at Söndreström, Greenland, on the westbound.

INCREASED FUNDS ASKED FOR U.S.A.F.

In his Budget Message to the Congress President Eisenhower asked for defence funds for the 1955-56 fiscal year of $34,100,000,000 (compared with $34,375,000,000 the previous year) out of total appropriations of $62,400,000,000. Distribution among the three armed services is as follows:

U.S. Air Force	$15,600,000,000 ($400,000,000 more than previous year)
U.S. Navy	$ 9,700,000,000 ($ 75,000,000 less)
U.S. Army	$ 8,850,000,000 ($ 50,000,000 less)

Defending the preference shown to the Air Force, Eisenhower stated that "nuclear-air retaliatory power of the Air Force and naval aviation" is the principal deterrent to Communist aggression. This policy is, if possible, expressed even more clearly in the estimates for aircraft procurement: of a total of $6,853,000,000 for the U.S. Air Force and the U.S. Navy, no less than $6,100,000,000 goes to the Air Force and only $753,000,000 to naval aviation.

MINISTRY OF AIRCRAFT PRODUCTION FOR BRITAIN?

Interavia's London correspondent reports on good authority that plans for a separate Ministry of Aircraft Production to deal with aircraft and aircraft equipment are now being drawn up. Sir Winston Churchill, who first voiced the idea some weeks ago in a Commons debate on delays in fighter deliveries, is said to approve of the project. - The original World War II M.A.P. had wide competencies (supervision of production and delivery date) but was dissolved at the end of the war, and its duties passed to the Ministry of Supply. For some time past both R.A.F. and airline corporations have been blaming the intervention of the Ministry of Supply between the industry and its customers for the misunderstandings, delays and overlapping in the British aircraft industry.

NAVY ORDER FOR REGULUS

The U.S. Navy has disclosed that it has awarded a $16,383,790 contract to Chance Vought Aircraft Inc. for Regulus ground-to-ground guided missiles. The Navy now has three submarines in the Pacific Fleet which could carry such missiles, the "Cusk", "Carbonero" and "Tunny". - Moreover the two 13,600-ton cruisers "Boston" and "Canberra" are nearing the completion of their conversion as missiles ships. Finally the atom-powered submarine "Nautilus", which began diving tests on January 20th, is also to carry Regulus missiles.

LOCKHEED ANNOUNCES RECORD SALES OF AIRLINERS

Lockheed delivered 41 new Super Constellations to 12 different airlines in 1954, with a total value of over $70,000,000, according to the company's year-end review issued in mid-January. This compares with total deliveries of only 28 commercial aircraft, valued at $43,000,000, in 1953. In dollar value 1954 production also exceeds the peak totals of 1946 and 1947, when the airlines were at the height of their post-war re-equipment programmes. - At the end of 1954 Lockheed had an order backlog for 68 Super Constellations.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

FAIRCHILD ENGINE & AIRPLANE CORP.

R. James Pfeiffer has been appointed Director of Commercial Sales, after seven years as Domestic Sales Manager for the Convair Division of General Dynamics Corporation. In the latter position he played a leading role in the marketing of the Convair Liner.

AERONAUTICAL RESEARCH INSTITUTE FOR JAPAN

A sub-committee of the Japanese Aviation Technical Advisory Council has completed the draft of a five-year plan for the creation of an Aeronautical Research Institute. The Institute is to be at the disposal of the Ministry of International Trade and Industry, the Transport and Education Ministries, the Defence Board and other Government agencies, as well as universities and private firms.

"PAY LATER" SYSTEM AND SPECIAL FARES FOR AIR FRANCE

At a recent press conference Air France President Max Hymans expressed the fear that there may be an air transport crisis in a few years unless effective measures are taken to prevent it. In 1954 average load factor was only 65%. - Air France was therefore planning to introduce the "pay later" system and special "off-day" rates in the spring.

FIRST SOUTH AMERICAN HELICOPTER CARRIER

The Brazilian Air Ministry has authorized the foundation of a helicopter company in Barbacena, the first South American company to plan scheduled helicopter services.

NEW AIR-SEA RESCUE METHOD

The Royal Navy's Search and Rescue Unit of the Naval Air Station at Ford, Sussex, has successfully developed a new method of rescue from the sea by helicopter, using a "scoop net" instead of a strop. The net, which may be compared to a fisherman's trawl-net, is attached to a D-shaped frame and is lowered into the water from the helicopter hovering at about 25 ft. above the surface. The net is then trailed through the water until the person is "caught". The new method makes it possible to rescue injured persons who are not capable of holding on to a strop.

* * *

WORKSHOP BRIEFS ...

A number of Japanese aircraft manufacturers have begun development work on light jet trainers: Shin Meiwa, Shin Mitsubishi, Fuji Juko and Kawasaki. All the projects so far worked out are for two-seat all-metal low-wing models; power plant envisaged is Turboméca Marboré II or Japan Jet Engine JO-1 * The second production model of the Bristol Britannia four-turboprop commercial transport has begun flight testing. Altogether four Britannias (the prototype and the first three production models) are to be used for the full test programme. Trials are expected to be completed by mid-1955, when the Britannia should get its certificate of airworthiness. * The American firm of Piasecki plans to market a civilian version of its H-21 military helicopter. * Development and construction costs of the Convair XFY-1 V.T.O. fighter prototype (Allison T-40 turboprop) amounted to $9,000,000. * A new (sixth) version of the Beech Bonanza sports and touring aircraft, the F.35, is now on the market. Engine, either 205 h.p. or 225 h.p. Continental. * Dassault Mystère XXVI, a light fighter and ground attack aircraft, is fitted with a Bristol Orpheus turbojet of approx. 5,000 lbs. thrust and has swept wings spanning 25.5 ft.; length 37.2 ft. * The production programme for the Vickers Viscount turboprop airliner calls for an output of 55 aircraft in 1955 and 98 in 1956. * The Helicopter Division of Saunders-Roe has built a mock-up of a helicopter cockpit for the Ministry of Supply, to serve as model for a more uniform arrangement and equipment of pilots' cabins. * Doman-Fleet Helicopters Ltd., of Fort Erie, Ontario, which holds production rights for the American-designed Doman LZ-5 six-seat helicopter, announces that flight testing of the first Canadian-built model will begin in March 1955. * "Super Rustfree Steels" (SR Steels) are a group of new steel alloys developed by Uniworld Research Corp. of America, Cleveland, and distributed by Eastern Brass & Copper Co., New York. Applications: atomic power plant, aircraft jet engines, chemical industry, gas and steam turbines, oil industry etc. * Lear L-10 is a new autopilot for supersonic aircraft made by Lear Inc., Santa Monica, California, using certain parts from the earlier Lear L-5 autopilot (standard equipment in the F-86D and F-84E).

*

"Ice Water Imperialism"

"Historical, political and legal facts give us a claim to full sovereignty over these Arctic seas. *We* conquered them; *we* are vitally interested in them. In these latitudes shipping has a special character due to the ice: the international rules governing the open seas cannot be applied in the Arctic . . . For all these reasons the Arctic seas are our national waters, whose legal status must rest on the unconditional recognition of the U.S.S.R.'s sovereignty."

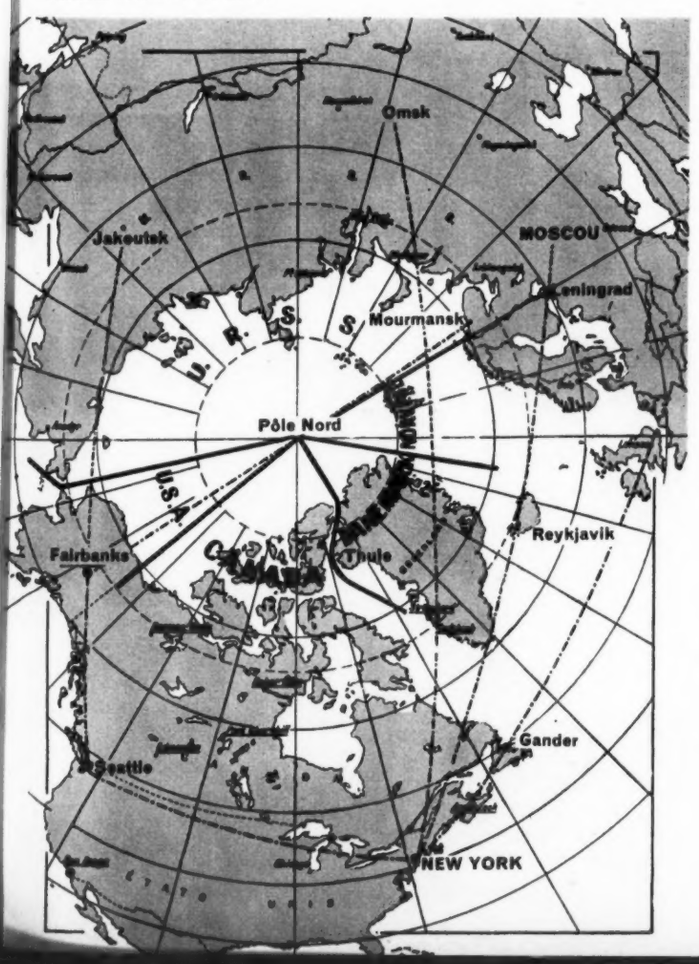
Even when it is recognized that the speaker is not talking about the whole Arctic Ocean but only those parts inside the Russian Polar sector, no claim could be expressed more unmistakably. And the Russian lawyer S. A. Vishnepolski, who made this statement in 1952, is by no means alone. The Soviet Arctic Research Institute and the Legal Institute of the Moscow Academy of Science have also adopted his view.

If the Russians needed any "justification" for their unbending attitude, they could assert with truth that they did not invent the so-called *sector theory,* but took it over ready made from Canada. Senator Pascal Poirier introduced it to the Canadian Parliament as long ago as February 19th, 1907, justifying it—like the Russian lawyer—on historical, political and legal grounds. He "shared out" the Arctic between four nations —Norway, Sweden, Russia and Canada (Denmark and the United States were passed over at that time)—and claimed in ringing terms that Canadian territory stretched to the Pole. But it was not until June 1st, 1925, that the Canadian Parliament passed a bill forbidding all access to the territories of the Canadian Arctic sector without Government licence.

On the other hand the Canadians too could protest that it was not they who "started it". They could "blame" Tsar Ivan the Terrible, who in 1582 brusquely rejected a British claim to fishing rights off the Siberian estuaries. The British Ambassador of the time was told very briefly that the British had no business in those waters . . . "It is our property".

The squabble about these icy wastes, in which cold, darkness and —at least until yesterday—hunger held sway, therefore has gone on through the centuries. In view of the hitherto doubtful value of these regions one can understand *André Siegfried,* the French author, who described the attitude taken by the Powers bordering on the Polar zone as "*Ice Water Imperialism*".

National Sectors of the Arctic.



*

To return to the Twentieth Century. The Russians did not long delay their answer to the Canadian law of 1925. By a decree dated April 15th, 1926, they declared all the islands and land areas in their sector of the Arctic Ocean as Soviet territory, and although the other Powers interested in the Arctic had never legally recognized the Russo-Canadian sector theory, this "mathematical method" of seizing possessions has tacitly asserted itself. The only exception to the sector theory is the Danish Arctic possession, Greenland, because Denmark itself does not border directly on to the Arctic.

The method of annexation customary in other regions of the globe—seizure, exercise of administrative power, etc.—could not be applied in practice in those inhospitable latitudes, at least not until today . . . It is not excluded that here again the aircraft will produce a profound change by opening up the farthest North to transport and settlement.

*

The sudden interest presented by the Arctic since the end of World War II is due to several causes. In years gone by the public became alarmed whenever an explorer and his ship or dog sled or some kind of aircraft vanished north of the Arctic Circle. It used to be a world sensation when a pilot succeeded in flying over the geographical North Pole or in tracing an Arctic liaison between the Old and New Worlds by air. Although all this was not very long ago, it is already ancient history.

Today the Arctic is in the news again . . . Both sides are mounting guard at the Pole. Flying at the Pole has become an everyday affair, a great deal more than the general public suspects. The Arctic is beginning to be peopled. In the years since World War II it has become a strategic air lane, a first-rate area of deployment.

But such military considerations should not overshadow an achievement by the descendents of the old Vikings. Since November 15th, 1954, a regular air service has been operated between the North of Europe and the West Coast of the United States by Scandinavian Airlines System. This is certainly a feat worthy of the Vikings. However, it merely marks a beginning.

A few years hence many commercial air lines will be crossing the Arctic between Europe, the U.S.A., the Far East and South East Asia. S.A.S. will have found its followers. *EEH*

The Importance of Arctic Flying

BY COLONEL BERNT BALCHEN, U.S. AIR FORCE

Editor's Note: *Bernt Balchen, the colourful Norwegian-born pilot, belongs to the earliest Arctic air explorers and looks back on a long career of Arctic and Antarctic flying. Born on October 23rd, 1899 at Tveit, Topdal per Kristiansand, Norway, he graduated from the Naval Flying School at Horten, Norway, as a pilot in 1921 and served until 1926. Even before he left the service his exploring activities had begun: in 1925 he helped search for Amundsen and Ellsworth; a year later he was an inspector and mechanic on the "Norge" expedition. On the latter expedition he met the American airman and explorer, Admiral Byrd, and accompanied him to the U.S.A. For nearly ten years he worked as a test pilot in his adopted country, interrupting his stay to take part in a variety of expeditions: in 1927 to pilot the aircraft "America" non-stop across the Atlantic to Paris together with Admiral Byrd (they nearly succeeded: the aircraft made a forced landing on the French side of the English Channel); in 1928 to 1930 as Chief Pilot of Admiral Byrd's Expeditions, piloting the first flight over the South Pole on November 29th, 1929; in 1933 to 35 as Chief Pilot of the Ellsworth Antarctic Expedition; and several others. Back in Norway in 1935 he became Chief Inspector of Det Norske Luftfartselskap (DNL), the Norwegian Airlines now forming part of Scandinavian Airlines System, and began to work on plans for a route across the Atlantic. He worked for the establishment of a Scandinavian Air Union in cooperation with the U.S. Government and Pan American Airways and made arrangements for a first trans-Atlantic proving flight to Norway; this should have taken place in 1940 but was prevented by the war. After the fall of Norway Bernt Balchen joined the Royal Air Force, ferrying aircraft across the North and mid-Atlantic and later from California to Singapore.*

He transferred to the U.S. Army Air Forces before Pearl Harbour in 1941 and soon had an opportunity of putting his Arctic knowledge to good use. In 1942 and 1943 he built the Bluie West 8 ferry air base in Southwest Greenland and commanded it for two years, taking time out to rescue numerous downed ferry crews from the Greenland icecap. Today BW. 8 is known as Söndre Strömfjord U.S.A.F. base and also as the intermediate stop on S.A.S.' new Copenhagen-Greenland-Winnipeg-Los Angeles Trans-Arctic air service.

The rest of the war Balchen spent in England as Chief of the Allied Air Transport Command for Norway, Sweden, Denmark, Finland and the Soviet Union. He commanded the U.S. air unit in Norway during the latter country's liberation in 1944-45.

At the end of hostilities he once again returned to civil aviation as President of D.N.L. Norwegian Airlines and helped to establish the foundations of today's S.A.S. As the cold war became hotter once again and the Far North assumed increasing strategic importance, he was recalled to active duty in 1948 as a Colonel, U.S.A.F., and once again assigned to the familiar North, this time to Alaska as Commanding Officer of the 10th Rescue Squadron. In 1951 he transferred to U.S. Air Force Headquarters in Washington, D.C., as U.S.A.F. project officer for the huge Thule Air Force Base in Northwest Greenland. Today he is on temporary duty with the National Science Foundation, Washington.

To his qualities as an Arctic pilot and explorer, Bernt Balchen adds those of an accomplished water-colour artist, as the black and white reproductions on these pages show.

The old Mercator projection map of the world, with its inhabited areas roughly in the center of the map, topped off at either end with the desolate, unproductive Polar areas, is not applicable any more to our geographical conception of our world. It is interesting to note that the large industrial and commercial centers—which in time of war would become the prime targets for the strategic air forces of the countries involved in an armed conflict—are practically situated between Latitudes 35° and 50° North.

Long range air traffic between the commercial centers, or, if war should come, long range air strategic missions between North America and possible targets in Soviet territory, will naturally take the shortest route—the Great Circle track.

The vertices of these airlines all converge towards the North Pole and into the Arctic regions. Up till now we have had two large areas of our globe that have not been the scene of large military strategic operations—the Arctic and the Antarctic regions. They have been considered of little or no commercial or strategic value, and anyway the logistical problems involved were regarded as too difficult to tackle with the knowledge so far available.

As far as the Arctic regions are concerned, the situation has changed most radically because they are located in the center of the big industrial and strategic target areas of our globe. One can say with justification that the Arctic from being one of our coldest areas has turned to become one of the "hot spots" of today and tomorrow.

This interest in the Arctic is partly due to recent discoveries of natural resources, and overwhelmingly to its new military strategic importance.

Bernt Balchen: "Mount Michelsen, Brooks Range, Alaska."

Bernt Balchen: "Bush Flying, Northern Canada, 1927."

In any future conflict it is reasonable to assume that the Arctic and sub-Arctic regions might be the areas from where some of the first, and maybe decisive, aerial attacks would be initiated.

Three of our inhabited continents, North America, Europe and Asia, meet at the ice-covered shores of the Arctic Ocean, and the extreme northern parts of these continents are the Arctic land areas.

The shortest routes—the Great Circle Tracks—between a number of industrial centers and military bases in North America and the Soviet territory, particularly points in the Ural and Siberian industrial complexes, all pass through the Arctic regions, and some of them nearly across the geographical North Pole.

This strategic aspect is very convenient for the U.S. Air Force's strategic bombing of industrial targets with modern types of high efficiency projectiles. Wiping out the war production potential of an enemy would greatly reduce our loss and costs of any future war, and our latest types of aircraft are well capable of performing these missions.

The low temperatures that would be encountered on these flights across the Arctic regions are no more severe than those met in daily operations at high altitudes anywhere else on the globe. On the whole, flights across the Polar regions offer no major problems due to our electronic aids to Polar navigation. High aircraft and engine efficiency and high proficiency of flight crews today add to make this type of operation practically daily routine flights.

On a military mission across the Polar regions, most of the track would be inside the Arctic circle and probably over the Arctic Ocean. With the exception of the southern parts of the Arctic regions, it is very unlikely that any opposition in the form of anti-aircraft, radar and defensive fighters would be encountered. The probable absence of opposition on about two-thirds of the entire trip would give the crews a better opportunity to concentrate on navigation and flight problems.

To quote the late General H. H. Arnold: "If World War III should come, the strategic center will be the North Pole."

To quote General Carl A. Spaatz: "Across the Arctic, any industrial target is within the reach of our Air Force. The United States is similarly exposed. We are really all open across the Arctic."

It is obvious from the above that, as we improve the range of our bombers—or, looking at the peaceful aspect of the picture, commercial long range non-stop operations, for instance between the West Coast of the States and India—flights would all cross the Arctic regions, and some of them very close to the Pole.

With the progress of aviation, military or civil, ground installations all over the Arctic land areas are needed for efficient and safe conduct of these operations. A complete network of weather and radar stations and also some emergency landing fields are required. These installations must become a permanent network to serve, first, as a defense line of the free world and, second, to support the airlines crossing these regions today and more so in the future.

As the payload range on our modern aircraft increases and our Polar network is augmented, more and more of the nations will avail themselves of the advantages in saving of distance and time by going through the Arctic regions. When, for instance, some day the world can take full advantage of this concept by flying over Soviet territory, Scandinavian Airlines System could cut the distance to Japan in half as compared to the conventional route across India. There will be new possibilities of providing shorter service to distant points on our Northern Hemisphere, possibilities that only air transport can give . . . and across the Arctic.

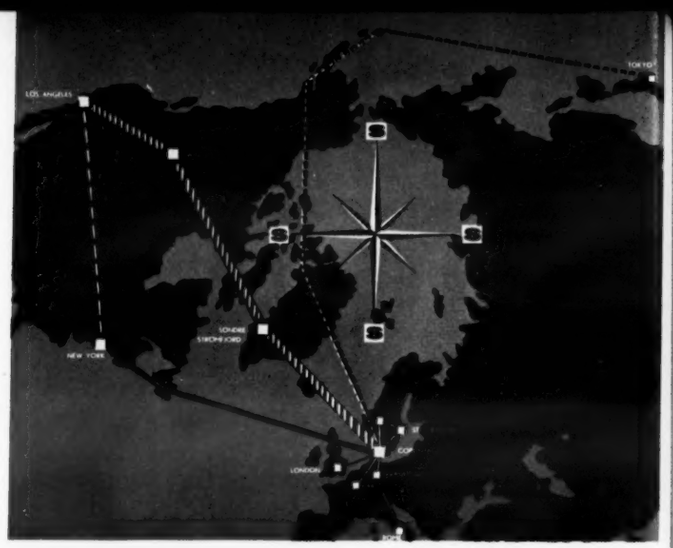
It is a great personal satisfaction for me to see the opening of these important air routes by my old company S.A.S.; and I am convinced that S.A.S. will be followed by the other airfaring nations. To give an example of the obvious advantage of the Arctic airways; in September 1949 I took off from Fairbanks, Alaska, with a U.S. Air Force Douglas C-54 *Skymaster* and made a non-stop flight to Oslo, Norway, a distance of about 3,800 miles. The return flight to Alaska was made via Washington, a distance of 8,000 miles. In other words, the Arctic route cut the travel distance to Scandinavia from Alaska in half.

I have been identified with Arctic air operations for a great many years now, but the opening of the scheduled routes across the Polar regions is by far the most important event that I have experienced.

Bernt Balchen: "Norwegian underground saboteurs under way to blow up the heavy water supply at Rjukan, Norway, in 1944."

Polar crossroads

By Arild Viking to the New World



A modest tablet fixed to the wall near the galley of OY-KME *Arild Viking*, a Danish-registered Douglas DC-6B of Scandinavian Airlines System, announces that on November 20th, 1952, this aircraft had made the first proving flight from Los Angeles to Edmonton, Alberta, across the inhospitable Northwest Territories to Thule, the new U.S. Air Force Base in the even more inhospitable North of Greenland, and from there to Copenhagen.

That was two years ago, to the day. For today is the 20th of November, 1954, and the *Arild Viking* is again winging its way along the Arctic routes. With a difference, however: this is the first *commercial* scheduled Arctic flight to be flown by the enterprising Scandinavians. It is following a slightly modified route this time, from Copenhagen to Söndre Strömfjord Air Force Base in Southwest Greenland—better known to wartime ferry pilots as Bluie West Eight or BW. 8—and thence to Winnipeg, Manitoba, across the States of North Dakota, Wyoming, Utah and Nevada to Los Angeles in California. Travelling time, 27 hours, compared with 32 hours—provided all the connections function—for the "conventional" route from Copenhagen to New York and by transcontinental airline to the West Coast; a saving of about 1,000 miles, in other words, a short-cut between Continents.

Arild Viking had been preceded on November 15th by *Helge Viking* on the official inaugural flight. That was hardly a commercial flight—the aircraft was crowded with Prime Ministers (three), Princes, Ambassadors, top airline officials, lesser airline officials, radio and television representatives and journalists. To us fell the honour of participating in the first paying-passenger flight, even though the aircraft *did* carry a sprinkling of journalists (three).

When we were told to pack our bags, get ourselves vaccinated (the Americans seem to believe that all Europeans are smallpox carriers) and fly to Los Angeles via the Arctic we felt pleasantly excited. Visions of Ellsworth, Amundsen, Nobile, Balchen, Byrd—these Arctic fliers are heroes, surely? Soon we would be able to say to our friends: "The Arctic, yes . . . A select band of hardy men have conquered it by air . . . I'm one of them." As it turned out we feel at most like a drawing-room hero . . . and more drawing room than hero. All we did was to sit in a comfortable chair and take it easy.

The ease of it all makes us think that those early pioneers who ventured into the Arctic by land and air weren't crazy at all. It wasn't their sole desire to stick a flag in the snow or drop it from aloft at a point in a bleak expanse of ice known as the North Pole. It was they who helped to make Arctic flying—including the S.A.S. service—a safe possibility.

*

For us, the trip starts at Geneva, Switzerland, home town of *Interavia*, early in the morning of November 19th. The DC-6B of S.A.S. roars into the morning mist, climbs through the overcast and slowly circles to gain altitude above a labyrinth of real and imaginary mountains, clouds and valleys. Breakfast is served, and almost immediately the aircraft

Switzerland . . . a labyrinth of mountains, clouds and valleys.

Hamburg . . . refuelling the DC-6B.

begins to let down again—or so it seems. In reality we have spent two-and-a-half-hours in the air and are approaching Hamburg. Touch-down, landing run—past brand new workshops bearing the inscription "Deutsche Lufthansa" —dead stop in front of the terminal building. Passengers remain seated, mechanics climb on to the wing, a fuel hose is hoisted up. A fresh take-off, a smooth flight over the plains of North Germany and Denmark, another landing at 11:30 a. m. Kastrup Airport, Copenhagen. Total travelling time, four hours ten minutes.

*

Copenhagen, shivering in watery sunlight. The Los Angeles flight leaves at ten past eight in the evening, so we decide to renew our acquaintance with the city. Fog closes in, painting a picture of white-in-grey-in-grey; even the merry little Mermaid of Copenhagen looks depressed. They say Danish girls are pretty: we couldn't say—they are all wrapped in coats and boots and shawls which conceal their aerodynamics. So we retire to a restaurant for lunch, an excellent one called "7 Smaa Hjem" ("Seven Small Houses" to you), which consists of seven rooms each furnished according to a distinct period (we land in a mid-Victorian atmosphere amidst small potted palms and antimacassars). Food served includes *Lidt men godt paa Platte, Kogt Pighvar, smelted smør og revet Peberrod,* and *Aegte Kinesiske Lychees med Rårem.* All this probably means something to a Dane, and perhaps we even ate some of it. It we did, it was good.

At three p. m. the Northern gloom begins to settle down on Copenhagen. We take a taxi, an enormous vehicle of indeterminate age and origin, which at one time or other must have been used to haul rocks about, and arrive at Kastrup to wait for our aircraft. Miss Inger-Lise Christensen, S.A.S. Public Relations Representative, takes charge of us plus an Italian and a German radio reporter and shows us around the airport.

We end up in the transit waiting room and bar. Kastrup's management know how to make you feel comfortable (others please copy).

*

Exactly on time, at 20:10 hours, *Arild Viking's* engines spring to life. The Air Hostess moves down the aisle and hands us the "Los Angeles Times" dated "Thursday Morning, November 18th, 1954"—i. e., yesterday. It had arrived at Copenhagen this morning on the eastbound Arctic flight.

20:13 hours.—*Arild Viking* begins to roll along the taxiway in the dark. The public address system hisses, the Captain's voice comes through: "Good evening, ladies and gentlemen, welcome aboard. The first leg of our trip—2,150 miles to Söndre Strömfjord—will take an estimated flying time of nine hours fifteen minutes. From Denmark we shall fly to Norway, cross the coast at Stavanger, pass the North Coast of Iceland, cross the East Coast of Greenland and fly over the Greenland Icecap to Strömfjord. The weather is generally good, but there is a depression near Iceland. Cruising altitude will be 8,000 feet, but over Iceland we shall climb to 16,000 feet. We hope you will enjoy your trip . . ."

20:18 hours.—*Arild Viking* has reached the runway head and is running up her engines, one after the other. At 20:23 hours the engines open up, the aircraft races down the runway, 30 seconds later it leaves the ground. For a few moments longer the reflection of the landing light glares between the two starboard engines, then goes out. A steady climb, no bumps at all, only an occasional tremor. At 20:40 hours we pass over the Oere Sund which separates Denmark from Sweden. To the left is Helsingör, to the right Hälsingborg.

The Air Hostess demonstrates how one uses the "Mae West"—the life jacket—just in case. Herr Ernst Schnabel, our new friend of the Northwest German Radio, protests. "I once swam three hours in one of those things during the war", he says; and he adds, "*ich wünsche heute nacht nicht zu schwimmen . . .*"

*

Travelling very long distances by air can be boring in the extreme. There is the hum of engines in your ears, hour after endless hour, with nothing to see, you're fed up with reading your newspapers, you have little space to walk about in. But on our travels with S.A.S. we have found that the Scandinavians have virtually licked the problem. They play the role of moral taxidermists. To keep your morale from sagging, they stuff you. You drink, eat

Kogt Pighvar, etc. . . . it was good.

Kastrup Airport, Copenhagen . . . a corner of the transit waiting room.

S.A.S. maintenance and overhaul hangars at Kastrup.

East Coast of Greenland. Colours: pink and blue-grey.

and drink until you fall asleep, and when you wake up you start all over again.

We have not been in the air very long, still impressed with the adventure of being Arctic explorers, when the steward comes along. "Drink, Sir?", he says, balancing a glass-laden tray. "Sherry, Scotch, Dry Martini, Manhattan . . . ?" We settle for Scotch. The Air Hostess hands us the menu—a neat little invention, engraved on a thin sheet of stainless steel. It says:

SCANDINAVIA-GREENLAND
SUPPER

Fresh Limfjord Oysters
Consommé Geraldine
Cheese Sticks
Roast Fillet of Beef
Asparagus — Sauce Trouffle
French Fried Potatoes
Salad Stockholm
"Top of the World" Ice-cream
Candy "Haakon VII"
Coffee Avec

The back of the menu card is equally interesting, for it shows the beverages you get before, during or after the meal. Everything you want is there: apéritifs, wines, brandies, whiskies . . .

*

Appetites fed and thirsts quenched, everybody settles down for the rest of the long haul. *Arild Viking* is a luxury first-class airliner fitted out to S.A.S.' DC-6B *Royal Viking* standards. Plenty of leg room, as far as you can stretch them. We could have the Air Hostess on our knees and she wouldn't touch the seat rest in front. (We didn't try the experiment.) What a relief to fly something other than tourist . . . or even *ordinary* first-class. If only we could afford it, we sigh, we'd *always* fly this way.

Söndre Strömfjord Air Base. Construction is still going on.

Breakfast is being prepared at Söndreström by U.S.A.F. cooks for S.A.S. passengers.

The new hotel at Söndreström.

On this first commercial flight only fifteen of the 32 seats are taken. The route is new, and many people are still reluctant to fly over the Arctic in winter, although Arctic weather conditions are actually better all the year round than the weather on the Atlantic. Somehow people seem to be less afraid of the idea of ditching in the Atlantic than landing on the ice. S.A.S. has a job of psychological selling to do and is doing it, for this is a long-term project.

A middle-aged American couple is seated somewhere in the centre of the cabin. Behind them is a bunch of young people, excited with the adventure of the so-called Polar flight. Without warning the American explodes: "Yack-yack-yack-yack-yack," he shouts, "why in HELL ain't they got a special compartment for the guys who wanna yack and not sleep?" The Air Hostess steps in and, gently smiling, leads the two to empty seats up front, where they fall asleep.

Arild Viking plows on through the night, with a rhythmic vibration. Rrrr–rrr–rrr–rrr . . . From time to time the landing lights flash on between the two engine nacelles: the pilot is checking on icing conditions.

One by one the passengers doze off, carefully provided with legrest and blankets by the Air Hostess, who also switches off the individual reading lights. Finally, there is only a small group of passengers who chat with the Hostess. She is a pretty 26-year-old Danish girl, Miss Tove Knudsen, who has been with S.A.S. for 2½ years and is as thrilled as most of her passengers at making the Arctic trip and visiting Los Angeles for the first time. It is the Hostess who tells us that we are actually travelling aboard the *inaugural* aircraft: *Arild*

Edge of Greenland Icecap.

The sun comes up over a sea of clouds. Colours: white, orange, brilliant red.

Viking hadn't been quite ready at the last moment, and her place was taken by *Helge Viking*.

*

We sit back in our chair as the aircraft drones along, fascinated by the red-hot glow of the exhaust manifold visible just under the cowling gills of the starboard inner engine. The flight is routine, we think—no bumps, no vibration, nothing unusual—and yet we are flying "the first new route since the aeroplane was invented," as it has been called. How much preparation was needed to make the route practical?

About a thousand people in Government offices in six countries and S.A.S. offices in 70 countries had been busy planning and preparing the new service for months—the work involved negotiations with the U.S.A. for traffic rights at Los Angeles, the training of hundreds of flight crew members in Arctic navigation and Arctic radio communication, the operation of six flights over Arctic Great Circle trajectories to the U.S.A., Canada and the Far East, and sixty flights between Copenhagen and Söndre Strömfjord. A 5,600 sq.ft. hotel was specially built in Greenland by the Royal Danish Greenland Trading Company—a Government-owned concern—for 1,000,000 Danish Kroner, or about $140,000. And all S.A.S. offices conducted a terrific campaign to herald the new route.

*

04:35 hours, Copenhagen time. A reading light winks here and there in the darkened cabin, one or two of the passengers stir uneasily. There is a slight click in the address system, followed by the familiar "hhhhh." The captain's voice says: "Ladies and Gentlemen, we are now flying over the Greenland Icecap." Now, the Greenland Icecap is a huge glacier—in fact, the grandmother of all glaciers. It covers 700,000 square miles and is 8,000 feet thick in places, and you could put all the glaciers of Switzerland into it and wouldn't notice the difference. We therefore crane our neck and see absolutely nothing in the pitch-black night except an incredible number of stars—in the cold, clear Arctic air the whole sky looks as if someone had poured milk over it. But underneath, nothing. The cabin is nice and warm, and if the captain had said we're flying over Honolulu we'd have believed him. The voice continues: "We have picked up a slight tail wind and shall be a little early. We shall now make a slow descent and land at Söndre Strömfjord in about thirty-five minutes . . ."

Everybody goes back to sleep. And then it happens: we see our first flying whatsit, it's not a saucer, but something. It sparkles brilliantly, like an oversize star, moves down slowly from high up in the sky, very low down, and then it moves up again, right over the aircraft. We shake Luca di Schiena, the Italian radio reporter, shouting at him: "Come—have a look at this . . . a flying whatsit or what is it . . ." He opens one eye and says, "Nuts. You didn't drink *that* much champagne last night." Now there is nobody who can corroborate our story.

04:55 hours. The captain's casual voice says: "As you may have noticed, we are flying over Strömfjord Airport. We are at 9,000 feet and shall descend. GCA will take us in. We'll land in about fifteen minutes." Behind us an American exclaims: "Jeez . . . never arrived over an airport at 9,000 feet . . . seems we're gonna make a power dive . . ." At 05:10 hours we touch down very gingerly, roll along a slightly iced-up concrete runway past dozens of blazing electric lights and countless buildings, taxi behind the familiar "Follow Me" jeep (this one has a brilliant electric sign), and come to a stop, about half an hour ahead of schedule.

It is cold, bitterly cold, as we climb down from the aeroplane. Some-one says it's 30 degrees below zero, Centigrade. We step into a U.S. Air Force bus containing a heat machine which blows up a minor tropical sandstorm in the interior, but at least it's warm. And here we see our first Eskimo, complete with parka and a fringe of fur surrounding his face. Except that he is a Negro and drives the bus for the U.S.A.F. We pass an illuminated board which confirms that we have *really* arrived: "Söndrestrom Air Base," it says.

Flying over Northern Canada.

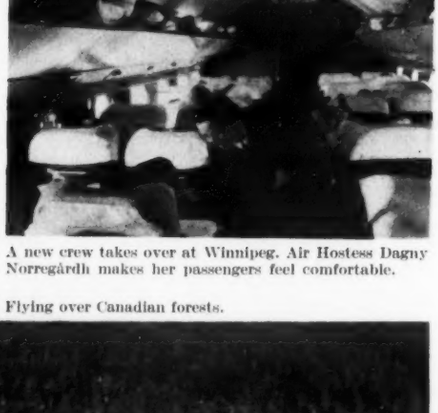
Polar crossroads

The well-heated hôtel is very new and smells of paint. They're still working on it, and it seems that between flights (four a week) they whip out the furniture to get on with the building job. Even at this stage it is very comfortable. Rubber-tiled floors, red sofas, soft lights, low tables, inviting chairs, a small bar. Danish beer is served.

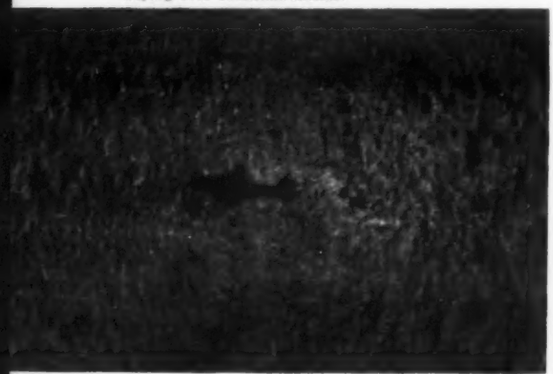
Söndre Strömfjord is a U.S. Air Force Base —650 nautical miles south of the big place up at Thule—and it is growing every day. Prefabricated aluminium buildings are being knocked together right left and centre, with work going on through the night under electric light. Power drills rattle, nails are hammered by hooded figures in the dark cold, quantities of lumber lie around in neat piles. Construction at present is in the hands of U.S. Army Engineers, but soon the U.S.A.F. will get its own construction teams. The base is situated at the mouth of the Fjord and now has a single runway of about 8,000 feet. Chiefly an air logistics base, it is well capable of handling the big Douglas C-124 *Globemaster II* transports and Boeing KC-97C *Stratotankers*. A second runway is to be built shortly.

Approaching Winnipeg airport.

Arild Viking at Winnipeg.



A new crew takes over at Winnipeg. Air Hostess Dagny Norregårdh makes her passengers feel comfortable.



Flying over Canadian forests.

The parka-clad Base Commander, Colonel Norman C. Spencer, Jr., just over forty, a twenty-year veteran of the U.S. Air Force, comes down to the hôtel to greet the civilian invaders of his stronghold. He has been here since last August. Everybody is curious about Greenland, because nobody has been here before. Ernst Schnabel of the German Radio, armed with Danish and American visas, even intends to stay a week. "Is Greenland always as cold as this?", asks one enlightened spirit. "N-no," replies the Colonel, " it all goes in cycles. Gets warmer now and again, say every 1,200 or 1,300 years or so. It's getting warmer right now."

"How many men have you got up here?" "Sorry, can't tell you. Why, the other day the Prime Minister of Denmark asked me the same question and I had to give him the same answer. He replied, 'But this is my country', and I said to him, 'But these are my men'."

There is a town of about 1,200 people just twenty-five miles away, the Colonel tells us. No, not Eskimos, they're Greenlanders. The difference? Well, says the Colonel, you could say they're Eskimos whose mother got to know a Dane rather well. They're very proud of their "race". They have about 300 kids—and what lovely kids they are. I have a little plane with floats and go and visit them now and then. No, the servicemen don't go to see them, the railroad doesn't run. Railroad?? I mean, we haven't built it yet. There is plenty to do up here. Hunting, for instance; no caribou (i. e., undomesticated reindeer), because they're reserved for the natives; but ducks, geese, ravens and foxes, plenty of foxes. They're small foxes, and all the foxes in Greenland seem to concentrate around this base, because of the garbage. Fishing is good, too. Salmon, for instance; and Arctic char, wonderful fish.

The men? Oh, they're here for a year, in rotation. You know the story? A man writes home: Dear Pop, we're stationed in a strange place but can't tell you where, we're enjoying it, shooting Polar bears all day. After a year he writes again: Dear Pop, I'm stationed in a strange place but can't tell you where, we're enjoying it, dancing with the hula girls all night. After another year he writes once more: Dear Pop, I'm stationed in a strange place, I'm not enjoying it at all, they say it's a hospital. Wish I'd danced with the Polar bears and shot the hula girls.

In the winter it's a little tough, of course, because there's no sun. On December 21st, for example, there's a little daylight, a kind of dawn, for only three or four minutes. That's nice, we think: a housewife could boil an egg and say to her husband when he comes home: "Darling, I've boiled your egg the whole day and it's just about ready . . ."

The men don't mind it here, the Colonel concludes, although their families aren't with them. Plenty of sports and educational activities. It's like being in the cinema to them. They enjoy it.

Outside we ask the shivering, fur-bedecked Negro bus driver: "How do you like it up here?"—"Ah don't," he says.

*

06:40 hours, Copenhagen time. *Arild Viking* begins to move for the take-off for Winnipeg, more than 2,000 miles away. At 06:46 she stops near the runway end, runs up her engines.

Wyoming cattle ranges.

Salt Lake City airport, Utah.

At 06:50 the engines open up, exhaust manifolds glow white-hot, the DC-6B tears down the strip. The runway is situated along a whacking big mountain which in the clear air looks perilously close. "Jeez . . . we're running in a tunnel, son," says the American behind us. After 40 seconds, *Arild Viking* takes off. Hundreds of lights, reflecting on the snow, pass under us; then darkness again.

The main cabin lights are switched off, individual reading lights stay on, but after a while they go out one by one, like candles on a Christmas tree. The Hostess asks us if we would like a cup of tea. Yes, please. When she comes along with her little tray we ask her to hand the captain a note of introduction which Inger-Lise Christensen had given us in Copenhagen, and after a while the skipper comes from up front and sits down next to us.

He is a tall, dark-haired Swede, the "most eligible bachelor on Scandinavian Airlines System," we are told later. He is Captain Göran Lind, 32 years old, Lieutenant of the Royal Swedish Air Force Reserve. He joined the old A.B. Aerotransport (now part of S.A.S.) in 1944 and has been flying the Atlantic since 1951. He has flown more than 9,000 hours, including 700 to 800 hours with the Air Force.

"We are carrying a regular crew of ten," the Captain explains, "plus three training crew. There is the captain, one co-pilot, two flight engineers, two navigator-radio operators, one radio operator for communications, two pursers and one hostess. In addition, we have the S.A.S. Research Navigator, one pilot under training, and an extra navigator . . ." We feel more than reassured—13 crew and 15 passengers.

Originally, the captain reminds us, S.A.S. planned to operate its Arctic service from Copenhagen via Thule in Northwest Greenland and Edmonton in Canada, but the Americans did not grant any landing rights at their semi-secret Thule base. However, the present, more southerly route is now considered preferable because, although a little longer, it is safer. Should anything happen, there are many more alternative airports on the first two legs of the flight. They are Keflavik on Iceland, Frobisher on Baffin Island, even Goose Bay in Labrador or Gander in Newfoundland, as well as several others, which make alternate routes possible if needed.

"Nothing to declare . . ." Customs facilities at Los Angeles Airport are primitive.

End of the road. *Arild Viking* in the heat of Los Angeles Airport. American Airlines maintenance hangar in background.

Flying conditions are nearly ideal in the North, Captain Lind says. There is very little icing even at moderate altitudes because temperatures are far too low; the only exception is the depression area North of Iceland. At Söndreström, for example, there is never a storm, merely a mild, 5-6-knot wind coming down from the Icecap.

Did S.A.S. make any special preparations for the new service, apart from the routine arrangements? Yes, says the Captain, S.A.S. built and paid for three new radio stations which work on the same frequency as the North Atlantic network. The three are high-frequency R/T facilities at Frobisher Bay on Baffin Island, Churchill on the Hudson Bay, and at Winnipeg. Each has, in addition, a VHF channel for short-distance communications. The stations are operated by the Canadians.

The Great Salt Lake, Utah.

The arrangement is very unusual inasmuch as ground facilities are not normally built and financed by an airline—especially in a foreign country—for a route which it has been authorised to fly. Later on we gather that S.A.S. does not regard this as a precedent and hopes to come to some agreement with the Canadian Government—or with any airline that may benefit by the facilities on future Arctic schedules. That there will be other Arctic services is a certainty. "This is only the beginning of it," says Captain Lind. "Just think—Stockholm–Tokyo in thirty hours, with one stop in Alaska . . ."

"The three stations are not all we did," Captain Lind informs us. "We also had to develop special Arctic emergency equipment and stow it aboard the aircraft. Of course, we try never to use it," he smiles. What does this equipment consist of, and were the aircraft modified in any way to cope with the route? No, he says, the aircraft were not modified, except for the addition of some navigation equipment, for it isn't any colder in the Arctic than at great operating altitudes anywhere.

The special safety equipment, calculated for a full complement of 32 passengers and the crew, is supplementary to the normal emergency equipment carried by intercontinental airliners. It includes the following items:

> 3 life rafts for 20 persons each, completely enclosed and therefore suitable for use as tents, each with an automatic emergency transmitter. A new, more advanced version is under development. One cooking pan; three gasoline stoves, with radiators, for cooking and heating, using the aircraft's gasoline for fuel; one emergency equipment box containing a dye-marker to mark red signals on the snow; a pair of snowshoes for the hardiest member of the party, who might be able to locate rescuers; two snow shovels; one rifle and ammunition, for hunting purposes; one axe; ten sacks with full Arctic equipment for one man each, thus enabling a sizeable rescue party to be formed, while the remainder of the aircraft complement would sit smugly in their tents. A sack contains a fur-lined parka with a fur-lined hood, a pair of fur-lined trousers, a pair of fur-lined boots, a pair of fur-lined gloves, and a sleeping bag. Food is available in the aircraft galley.

Very cosy, we say, all this would make a gentle emergency landing on the top of the world almost a comfortable little adventure. Captain Lind fails to agree.

Did the crew undergo special training before taking up their Arctic flying duties, we ask. "Certainly. First we had to undergo a special navigator's course at Stockholm, directed by the S.A.S. Research Navigator, Einar Sverre Pedersen (who is on board today). Then we went through a five-day course on Arctic weather briefing and emergency training. Navigation is the most important, of course, because, you see, the magnetic compass is unreliable between Bluie West Eight (Söndreström) and the Southwest Coast of the Hudson Bay. But perhaps you would like to speak to Mr. Pedersen . . .?"

Mr. Pedersen explains all there is to know about Arctic navigation. He is well qualified to do so, for it is he who has tested all the equipment in the course of numerous proving flights. Pedersen is a Norwegian, born at Trondhjem in 1919. He graduated as a mining engineer and at the outbreak of war joined the Norwegian Air Force as a pilot. After the collapse in 1940 he joined the R.A.F. and was sent to Canada for further training, this time as a navigator. His operational service he performed with R.A.F. Coastal Command. He has logged about 8,000 hours in the air, is married and has a seven-year-old son who wants to become a rocket pilot. Pedersen supervised the Arctic navigation training of all S.A.S. flight crew and even now shuttles to and fro between Copenhagen, Greenland and Winnipeg as an instructor and check navigator. What he told us is recorded elsewhere in this issue.

*

We wake up suddenly, after what seems a long sleep. "Hhhhh . . ." whispers the address system. "Good morning, gentlemen," says the indefatigable captain. "We are now 2 hours 15 minutes from Winnipeg." It is as dark as ever, so when the steward comes around with a cup of coffee we ask him what time it is. Three minutes past six, he says, but we don't know if he means yesterday, tomorrow or next Friday. Later I find out that it is 13:03 hours Copenhagen time . . . tomorrow, of course. So we get ready for breakfast. After a little while we get lunch, in the middle of the night. A flying madhouse.

It starts off with the steward's polite enquiry, "Sherry, sir?" Yes, thank you. "Cigarette, sir?" Yes, thank you. (Never say no, it's all on the house.) Then we peep at our stainless steel menu. It says:

GREENLAND - CANADA

CONTINENTAL BREAKFAST–LUNCH

Scandinavian Plate
Fillet of Sole à la Walewska
Cheese and Crackers
Assorted Fresh Fruit
Petits Fours
Coffee Avec

At the left the sky begins to flare up in brilliant shades of orange and red. This means we are flying dead south. It is 6:50 hours. At 7:30 the sun comes up over an endless sea of clouds. Above is more cloud, scattered, all pink. It is 14:30 at home.

8:00 hours. "Will you please fasten your seat belts?" Five minutes later we pass over Winnipeg, a sprawling place. A sign of civilization strikes us after Greenland—a train, the engine trailing a plume of white smoke. At 8:17, about an hour ahead of schedule, the aircraft rolls to a stop before the airport building. A Canadian official comes aboard, checks our vaccination certificates. After that we are herded into an uninviting waiting room where we have to wait out the time gained plus the normal stopover time. Punctuality is the watchword. Neither ahead nor behind schedule. But the Canadian Department of Transport might take a look at Copenhagen and install, let's say, a modest little coffee bar in that sad waiting room.

We say good-bye to Captain Lind, Miss Kundsen and their faithful helpers. Another crew is taking over. They have spent two-three days in Winnipeg. "What a dump," they say, "we'd rather be dead."

At 16:30 (or 9:30 local) *Arild Viking* is airborne again. A new voice comes over the loudspeaker. "Six hours' fifteen minutes flying to Los Angeles . . . about 1,650 miles . . . 18,000 feet cruising altitude . . ."

It is full daylight now. The enormous vastness of Canada, its emptiness, the absence of villages and even individual houses is impressive to European eyes, used as they are to a cluttered-up countryside.

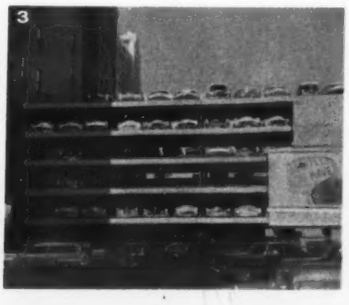
Greenland-California. From ice to blooming hibiscus bushes.

Booming Los Angeles, city of . . .

. . . contrasts: new cars in new "parking lot".

. . . and an Overland veteran of 1912.

. . . "super-markets . . ."



"Polar Pin-ups"

1 Inger-Lise Christensen, S.A.S. Public Relations, Kastrup. **2** Distinguished passenger: Chester A. Rude, Vice-President of L.A. Chamber of Commerce, banker, Board Member of North American Aviation. **3** Distinguished passenger: Mike E. Oliveau, European Representative, Douglas Aircraft Co. **4** Captain Göran Lind, S.A.S.'s "most eligible bachelor." **5** Miss Tove Knudsen, *Arild Viking's* Danish hostess. **6** Einar Sverre Pedersen, S.A.S.'s Research Navigator.

7 Colonel Norman C. Spencer, Commander, Söndreström U.S.A.F. Base. **8** On the job: Italian radio reporter Luca di Schiena interviews U.S. airmen at Söndreström. **9** Our "first Eskimo." "Ah don't," he said. **10** Miss Dagny Norregårdh, *Arild Viking's* Swedish Hostess. She also looked after *Helge Viking's* "official" flight from Copenhagen to Winnipeg. **11** A. M. "Rocky" Rochlen, Douglas Aircraft Vice-President, shows us the Hollywood nightspots. This is called "The Luau." **12** Señorita Lupita Moran, star singer at Casa la Golondrina, on Olvera Street, L. A.'s original Mexican Café.

Our nostrils begin to twitch. There is a familiar odour in the air—yes, you guessed it: FOOD. It is 10:30 a. m. local time or 17:30 Copenhagen time, so it seems cockeyed either way—but there on the little stainless-steel menu card it says:

CANADA–UNITED STATES
OF AMERICA
CAPTAIN'S DINNER

"The Cocktail Hour"
Russian Caviar & Goose Liver
Cream of Mushroom Soup
Roast Wood Grouse
Petits Pois — Carrots — Pommes Noisettes
Cheese and Crackers
Royal Dessert
Coffee Avec

We eat and drink all down the list, right to the "Avec", which is brandy. Shortly after that one of the stewards offers us grapes, bananas, oranges and apples, and just as we are beginning to feel like an asthmatic goldfish the steward appears again. "Port wine, sir?" he inquires suavely. Okay, let's have that as well, we're not partial. In a minute we'll wake up and die.

*

We are now flying over some of the most dramatic country in the world, North Dakota's and Wyoming's mountains, hills and cattle ranges, Utah's salt lakes, Nevada's dry stretches; the Sierra Nevada; Salt Lake City, Las Vegas. Heavily cultivated areas followed by mountains, woods, plains, deserts.

At 13:05 hours (22:05 hours Copenhagen time) *Arild Viking* lands at Los Angeles International Airport, one hour fifteen minutes ahead of schedule. The door opens—and phiooo! the heat pours in. Thirty degrees Centigrade . . . the same as in Greenland, only plus instead of minus. Men in "Truman shirts," girls in less than that, banana bushes in bloom. A small heat wave, on November 20th. An interminable two-hour wait in the immigration and customs hall, which is far too small for even the present, relatively light international traffic. But the officials are meticulously polite, almost cordial, to their perspiring customers.

After that we are swallowed up by that rushing, energetic, ever-expanding city, Los Angeles, which today already measures forty miles from one end to the other and is literally bursting at its seams. A city proud of its most ancient thoroughfare, Olvera Street, which is barely a hundred years old, and a few yards from it builds ten-lane "freeways" which are congested as soon as they are opened. The city of super-markets, aircraft manufacturers and film stars. What strikes us most are all the "foreign" car licence plates, "California 1954." The trip was so short that we still expect to see Geneva licence plates.

Sunny California! On the return flight the sister ship to *Arild Viking,* another Douglas DC-6B called *Gran Viking,* is delayed at Los Angeles for twelve hours by—thick fog.

P. A. B.

. . . strange advertising (ghosts of Evelyn Waugh) . . .

. . . eight-lane "Freeways."

The sun goes down at Santa Monica Beach.

Sunny California. Fog at L.A. airport.

Mounting Guard at the Pole

BY INTERAVIA STUDY GROUP

From now on, S.A.S.'s Douglas DC-6Bs will be periodically mobilizing the operators of some of the radar stations which keep watch over the empty Arctic skies. Two years ago, when jet airliners were operating services between Europe and South Africa, squadrons of fighters climbed up to meet them, guided by ground radar. Pilots and radar operators at last had a suitable "dummy target" on which they could practise for their future mission. The same applies to the Far North, now that the Arctic skies are beginning to be peopled. Though the new route opened by S.A.S. passes by at a tangent to the Arctic, it has pierced the wall of distance and cold which formerly covered the Northern approaches to the New World.

*

Last May 5th, a Soviet Ilyushin 12 suddenly "buzzed" the American camp set up two months earlier on a drifting ice island. At the time, the island, called T.3, was 250 miles from the Pole. In March three C-54s and a C-47 had circled over T.3. The C-47 landed to set down three men and camping equipment. For two years the slow evolutions of T.3 had been followed by the reconnaissance aircraft of General Old, Chief of Alaska Command. Shaped like a bean six to nine miles in diameter, T.3 drifted along an ellipse with the centre at approximately 80° North and 150° West. The ellipse approached the Pole to the North-East and the coast of Alaska to the South-West.

Following routes almost parallel to T.3 and less than sixty miles distant are two other Polar camps, PN.3 and PN.4, also floating on the American "slope" of the Arctic Ocean. But PN.3 and PN.4 are occupied by Russian detachments.

On both sides of the intangible frontier of ice and solitude, meteorological, atmospheric and ionospheric soundings are being made, and experts are studying the earth's magnetism, cosmic radiation, the ionization of the air and its ozone content. *But above all, both sides are marking their presence,* half way along the direct route between the respective sources of power of the two *blocs*.

A study of the globe shows that T.3 is five hours by B-47 six-jet bomber from Moscow, and PN.3 and PN.4 are 5 to 7 hours flight from Detroit. The shortest routes from New York to Tokyo, Chungking and Moscow pass inside or tangentially to the Arctic Circle. Thule, on the West coast of Greenland, is 2,800 miles from the Soviet capital, 3,100 miles from Omsk and similar distances from Stalinsk and Irkutsk. And from Franz Josef Land to the Great Lakes region the distance is only 3,400 miles . . Only 3,400 miles, less than seven flying hours.

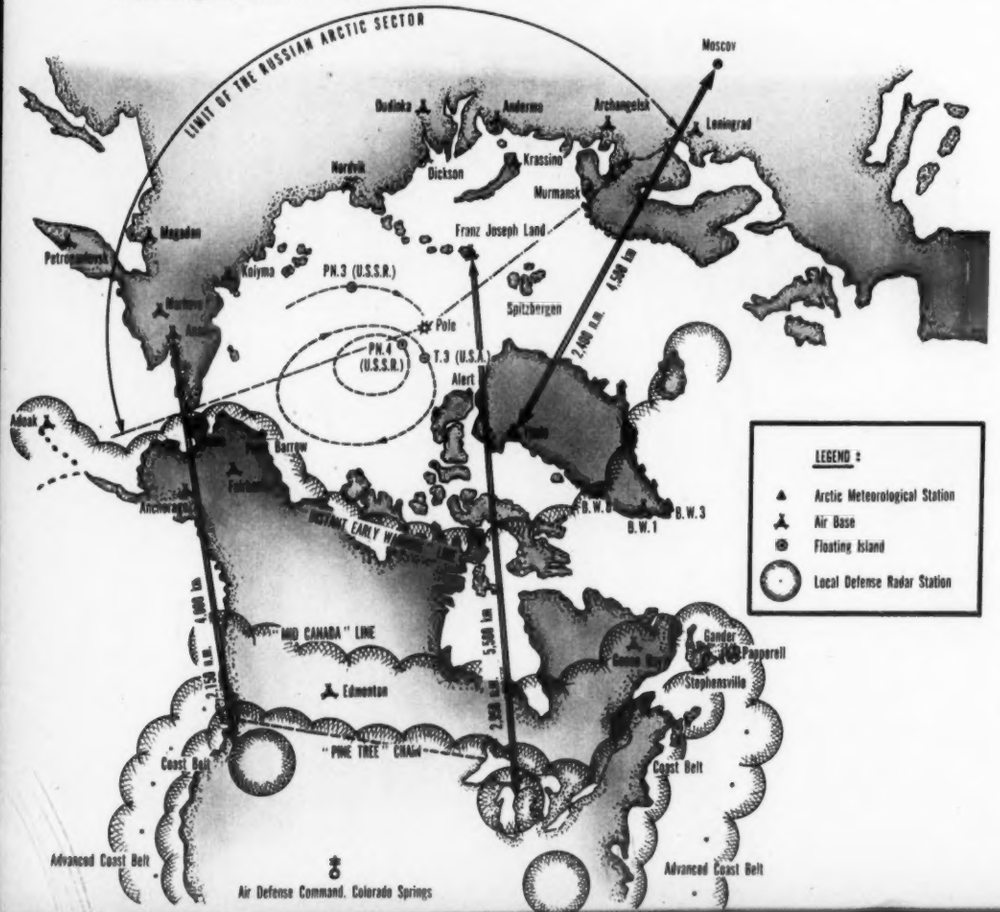
*

What the strategists on both sides fear is the use of the Arctic ice as floating supply bases. Four-engined bombers would then find there the fuel needed for non-return missions to distant targets. If the attacking aircraft are powered by piston engines or turboprops, they could be refuelled on the pack ice on both the outward and the return flight and thus gain sufficient range to bring them within reach of the most distant targets. So far, aircraft designers have not been altogether successful in combining high speed and long range in the same aircraft. The Arctic landing furnishes a solution to this problem, by guaranteeing both speed and extra range. For the military here, the "deterrent to aggression" takes the form of keeping informed and making it impossible for the other side surreptitiously to turn the ice into a spring-board for an air assault.

*

By the advance it has just made to the vicinity of the Pole, the U.S. Air Force is making up for lost time and compensating a geographical fact of which its potential adversaries have taken advantage: 25% of Soviet territory is

The threat to the American Continent resulting from the sudden feasibility of trans-Polar strategy has obliged the United States and Canada to create a defence system deployed over considerable depth. The measures needed – construction of radar belts and ground defence stations, creation of fighter units, training of volunteers for the observer service against low-flying intruders etc. – will cost billions of dollars, and it will be many years before the dangerous breach along the Arctic Ocean can be closed.



in the Arctic zone. Several million men now live on the shores and even in the interior of the Northern seas, and it is many years since the U.S.S.R. began the organization and equipment of the Northern shores to duplicate the single direct link between East and West of this vast empire formed by the Trans-Siberian Railway. Lenin founded the Arctic Research Institute in 1920, but it was not until 1943 that the first American military aircraft was fitted with skis instead of wheels.

On April 15th, 1926, the Soviet Government announced the boundaries of the Arctic territory and water which it claimed as Russian. From North of the Kola peninsular in the West, to the centre of the Behring Straits in the East, from the Pole to latitude 62° North, i. e., over a depth of 750 miles from the shoreline, air, sea and land were declared an integral part of the U.S.S.R., and from 1936 onwards were placed under the authority of the Administration of the Northern Maritime Route, or Glavsevmorput.

Before the Soviet era, the Russian Arctic was merely an exploration region. Ground frozen to a depth of 650 ft., pack ice to the North, lichens and, further south, forests, rivers and mountains still unexplored, were the features of a world which did not provide the essential conditions of existence for more than one inhabitant per 40 square miles. Austro-Hungarian, Norwegian, Danish, Swedish (the latter discovered the North East passage in 1879) and Russian expeditions plotted the location of the islands and explored the seas. But systematic study and exploration of the Russian Arctic did not begin until 1920. In 1929, Franz Josef Land, discovered in 1873, was annexed, and in 1934 an air base was installed there. From 1923 to 1938 permanent stations were built at Novaya Semlya, Severnaya Semlya, on the Liakhov islands and Wrangel. In 15 years 70 Polar stations were set up. Since then their number is estimated to have grown to more than 500. Ports have been built and an Arctic air network set up, along which Russian *Dakotas* distribute freight to all the new towns.

Mushroom towns along the Arctic Circle

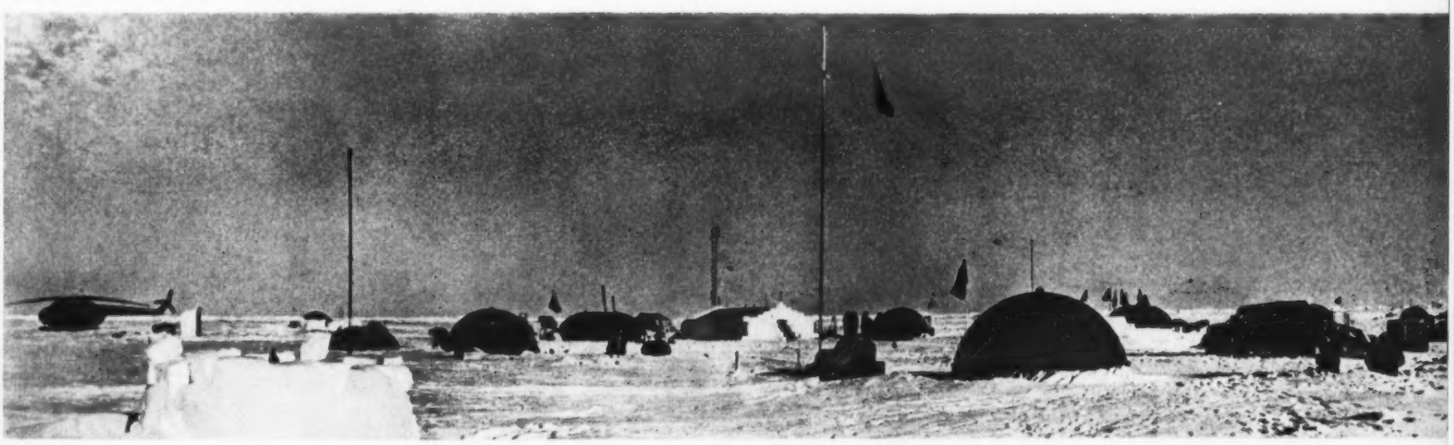
The history of Murmansk is an example of this development. A workmen's camp in 1915, Murmansk today has 300,000 inhabitants. It is far and away the first of the Arctic towns since it is situated more than 185 miles North of the Arctic Circle. Deportees and political prisoners provide an abundant source of labour.

The Russian meteorologist Georgii Matveichuk making readings in the Polar night.

Camp on a Russian ice island. — Helicopter, butane gas stove . . . everything is provided.

Comparing the Old and New Worlds, E. Armstrong, an English expert, points out that the Soviet sector is far in advance of Canada. The Russians, he says, have been working much longer and more stubbornly than the Canadians on the realization of their plans. Canadians are fewer in number and have not the same labour force at their disposal. In the technical domain, too, the Russians are in the lead, for example, as regards building on permanently frozen ground, laying railways, prospecting for oil wells. The Canadians, too have their Northern sea route, from the North Atlantic to Hudson Bay, by which they transport the wheat stocked at Churchill. It resembles the Russian lumber route through the Kara Sea, except that the Soviet line is more flourishing . . .

Russian scientific station on a floating ice island in the central Arctic.



The Russian prefabricated Arctic huts look like freight trucks without wheels.

On December 3rd, 1945, Admiral J. Papanin, hero of the 1937 Polar expedition, wrote in "Pravda": "Our comrades' flight to the rescue of the *Chelyuskin's* crew (imprisoned by the ice in the Chukotsk Sea) was considered as very hazardous (the title of Hero of the Soviet Union was created to mark this occasion). Then Bodopianov and his comrades disembarked a Soviet expedition in the middle of the Arctic Ocean. Our group worked for 270 days on the drifting ice. Chkalov and Gromov's crews flew over the Pole to reach America. Every year dozens of Soviet boats go from East to West and West to East by the Northern sea route. Our air routes cross the Arctic in all directions. And when our airmen venture far out over the ice in powerful aircraft, covering 2,000 to 2,500 miles in a single flight of 12 to 15 hours, this is no longer considered to be anything extraordinary or heroic. Our Arctic has expanded . . ."

Besides the commercial airports along the shore and the air navigation and meteorological network which enables several hundred miles to be cut from distances, the islands have also been opened up. Some of the 70 islands of Franz Josef Land, the huge island of Novaya Semlya, the islands of Bennett and Novaya-Sibir, except for Wrangel Island which is always enveloped in mist, might form the first stepping stones in the trans-Arctic ford. Altogether some 150 airfields have been constructed. Further North, Northern Spitzbergen—which, though Norwegian, might be occupied—is 40 minutes flying time from the meteorological station *Alert* mounted by the U.S. Air Force in the extreme North of Greenland. Finally, to the "South" of the Pole, on the American side of the earth's axis, watch is kept by the men on PN.3 and PN.4.

The rush towards the North

What is the West doing to meet this organized advance towards the North? World War II demonstrated the importance of the Arctic, and in 1941 the United States and Denmark agreed on measures to prevent an invasion of Greenland and on the establishment there of

During the Polar summer there is plenty of shipping in the bay off the American base at Thule (Northwest Greenland). All cargos must be unloaded and the boats on their way back to the South before sunset. — i. e., before the onset of the months-long Polar night.

In Greenland the U.S. Air Force uses steel huts set up direct on the snow, into which they gradually sink. When they have disappeared under the snow, they are reached through hatches.

Vehicles and materials being unloaded in Thule harbour for the U.S. Air Force base.

meteorological observation stations. From having always been excluded from world conflicts, the great Northern island suddenly took on strategic importance. Ten years later, in 1951, the U.S.-Danish agreements were reinforced, and Greenland has been progressively equipped by expeditions composed of Danish and American experts. At the same time Colonel Bernt Balchen was arousing the U.S. Air Force, equipment was "winterized", new techniques perfected and training schools set up to familiarize personnel with Arctic life.

From being a trans-Pacific point of call and a simple link in the chain of bases joining the United States and the U.S.S.R., when the two were allies against Germany, Alaska has become an advanced defence bastion. It faces the extreme Easterly portion of the U.S.S.R. and the naval and air bases that have been installed there. One infantry division is now stationed at Anchorage, and an air division mounts guard from Nome, Kodiak and Point Barrow. At the other end of the Northern front, the multitude of meteorological stations, the construction of Thule—at a cost of nearly $ 300,000,000 — and of BW.1 and Söndre Strömfjord (BW.8), the provision of two all-weather fighter wings and the construction of radar detection stations, form a counterpart to the defence preparations in Alaska. But there still remains the gap of the Canadian North to be filled. Here there is neither radar nor airfield over a distance of more than 1,200 miles. Earth and sky are denuded of all defensive organization.

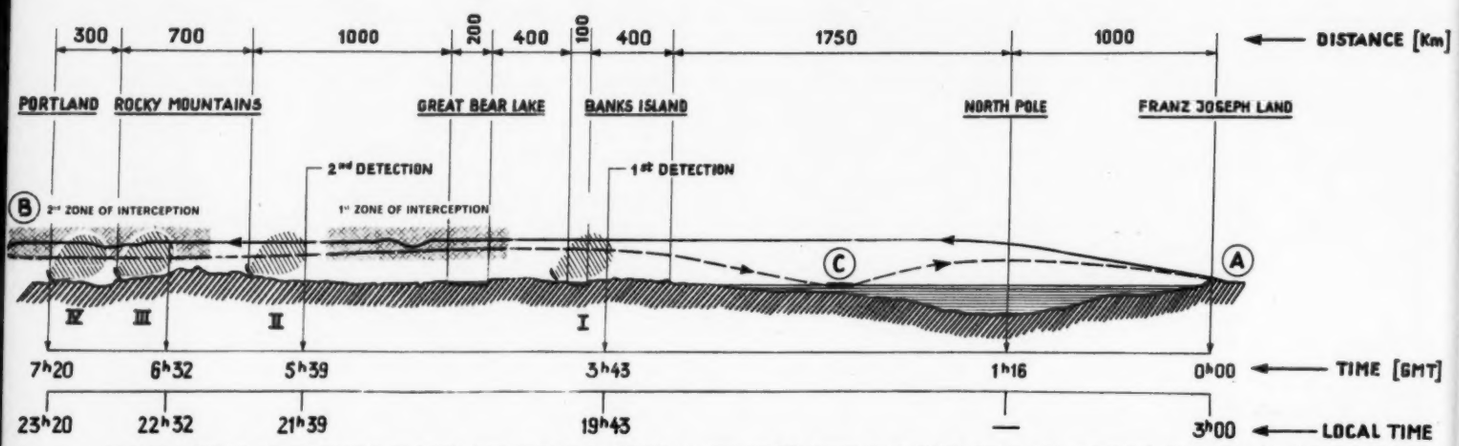
Fifty years of work

A fifty-year plan has been projected by the Canadian Government to develop and defend the Polar regions. Under a Canadian-American agreement, an advanced radar chain is to be built approximately along the 70th parallel, from Alaska to Greenland. This line (DEW = distant early warning) will take years of work and cost around 1,000 million dollars. Before it can be completed, the difficult problems of power supply, protection against cold and wind—experiments have been made with radar aerials under plastic cupolas—and of acclimatizing men to life under Arctic conditions must be solved. Behind these advanced radar stations there is the "Mid-Canada Line", roughly along the 55th parallel. It is partly in operation, but the warning it supplies will be too short. Still further South, a third line of stations, the "Pinetree Chain", is nearing completion. It will keep watch on the U.S.-Canadian border. Finally, inside the United States, local radar stations cover critical targets.

There will thus be four electronic barriers between the Pole and the sources of American power and life. The most northerly will be some 1,850 miles from Chicago and will give a warning of three or four hours, if not more. The Pacific and Atlantic seaboards are already covered, but because of the relatively short range of the ground radar stations, an advanced

U.S. oil tankers pumping fuel through floating lines into big shore tanks at Thule Bay.

Polar crossroads



Less than eight flying hours separate the Soviet bases on Franz Josef Land (A) from possible targets in the United States, such as Portland, Oregon (B). Any heavy jet bomber today is capable of making such a flight. However, fuel for the last stage of the return flight would have to be taken on during an intermediate landing on a floating ice island (C) in the Northern Arctic. When the DEW line (I) is completed, the bomber may be detected within four hours of take-off, before it reaches U.S. territory. Thus it would be advisable to have a first fighter defence zone to the South of the Great Bear Lake, provided that a sufficient number of fighter bases could be built in this difficult country. On crossing the Mid-Canada Line (II) the attacker would be detected and pursued a second time – still two hours' flying time from its target.

The "Pinetree Chain" (III) and the local radar networks (IV) form a defence zone deployed in depth, in which fighters and ground defences can operate for almost an hour. If the first alert (for bombers taking off at 0 hrs. GMT) were given at 3.43 hrs. GMT, the fighters would have sufficient time to prepare their combat mission before the bombers' arrival in their sector. It would take only a few minutes for the movements of the enemy, at any point in an air space of approx. 90,000,000 cubic miles, to be reported to the U.S. Air Defense Command headquarters in Colorado Springs.

belt at sea more than 120 miles from the coasts is under consideration. Finally, special early warning versions of the *Super Constellation* carrying six tons of electronic equipment will survey the air space hundreds or even thousands of miles from the coast.

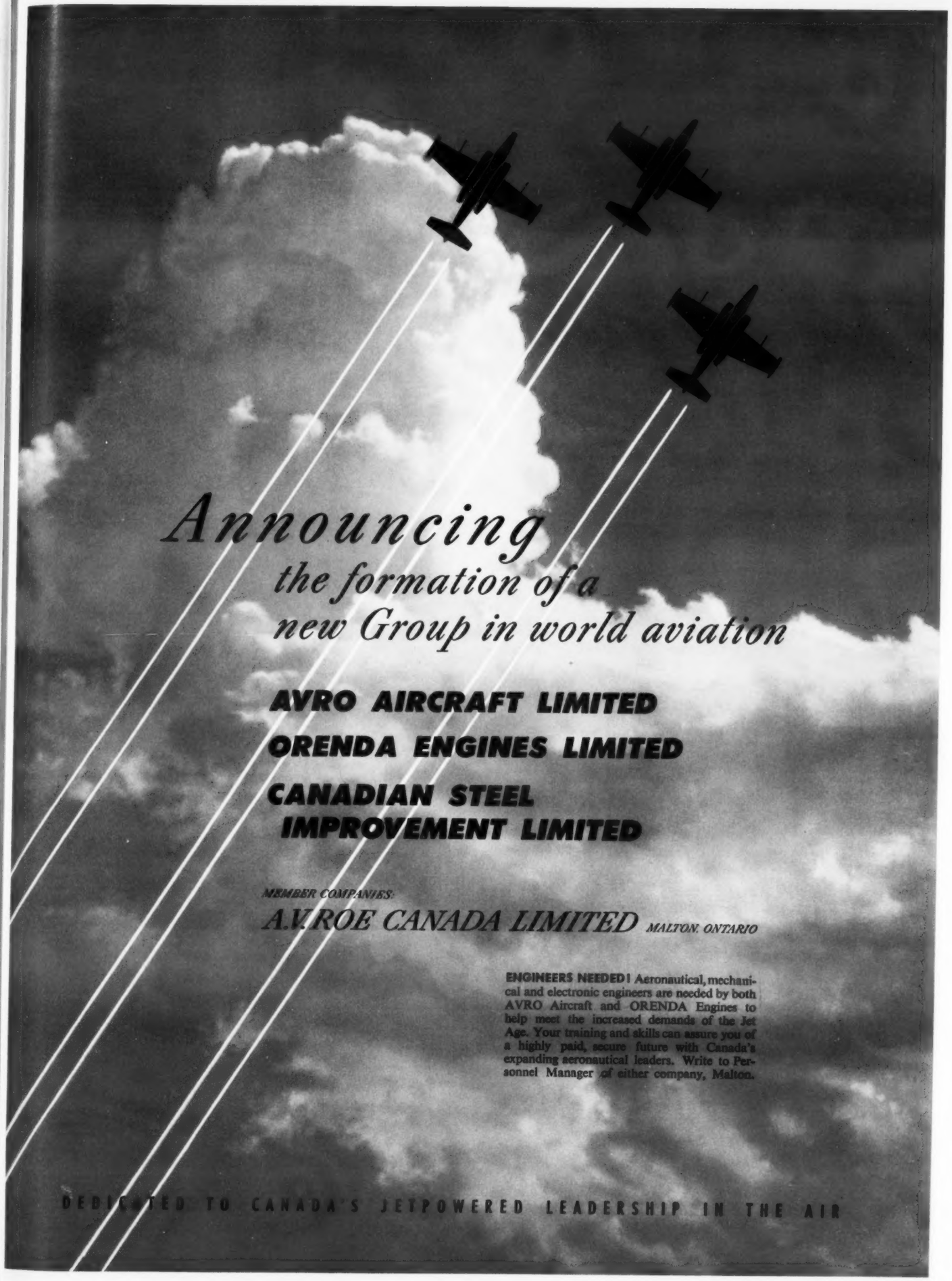
*

Passing suddenly from the concept of wars waged along the parallels to that of defence organized according to meridians, the United States are pushing their efforts towards the pole, in conjunction with Canada, and erecting, between the hostile Arctic and the territory it must defend, four electromagnetic belts to detect an attacker and guide its own interceptors.

This new theatre is roughly 3,000 miles square. Nearly 9,000,000 square miles to be defended to an altitude of 10 miles, or 90 million cubic miles of air space. The 2,000 aircraft of the U.S.A.F.'s Continental Air Defense Command and the Royal Canadian Air Force will thus each have to cover 4,500 square miles of territory and bar off about 45,000 cubic miles of sky. It is planned to supplement them with more than 150 radar stations, about 100 batteries of missiles of the *Nike* type, thousands of 3.5-in. cal. anti-aircraft guns and hundreds of radar-controlled *Skysweeper* guns. Finally, 400,000 volunteers will keep watch against low-altitude penetrations. Altogether 700,000 men, an investment of billions of dollars and an annual upkeep cost of more than 3,000 million dollars. It may be said that 75% of this expenditure is due to the opening up of the Arctic as a strategic area.

Northrop F-89D *Scorpion* twin-jet all-weather fighter of the U.S. Air Force's Alaska Command . . . with wing tips and tail unit painted red for Arctic operations (to facilitate location by rescue crews).

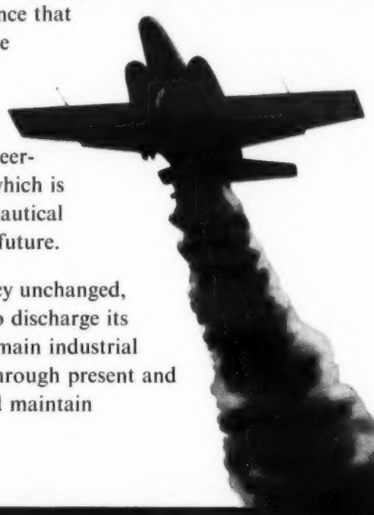
It will be many years before this system can be mounted in its entirety. The fact that the Pentagon has underwritten such a gigantic undertaking would seem to indicate that it does not consider that hypersonic missiles with ultra-ionospheric trajectories will constitute any real threat for some long time to come. Meanwhile, during the next ten years, design offices will doubtless be working to increase the range of heavy piloted aircraft while maintaining, or even augmenting, their speed. At the end of this period there may be intercontinental missiles with turbojet or ramjet propulsion, taking their supplies of oxygen from the atmosphere. V2s with hemispheric range and atomic warheads, and capable of seeking out the target assigned to them, will not appear until much later, by which time the radar belt will have served its purpose.


Announcing
the formation of a
new Group in world aviation
AVRO AIRCRAFT LIMITED
ORENDA ENGINES LIMITED
CANADIAN STEEL
IMPROVEMENT LIMITED
MEMBER COMPANIES:
A.V.ROE CANADA LIMITED MALTON, ONTARIO
ENGINEERS NEEDED! Aeronautical, mechanical and electronic engineers are needed by both AVRO Aircraft and ORENDA Engines to help meet the increased demands of the Jet Age. Your training and skills can assure you of a highly paid, secure future with Canada's expanding aeronautical leaders. Write to Personnel Manager of either company, Malton.
DEDICATED TO CANADA'S JETPOWERED LEADERSHIP IN THE AIR

Take off
FOR
AVRO AIRCRAFT

A world-famous name sharing a heritage of 46 years of flight takes off on its new career. With its own established record of design and production achievements reflected in the constant output of CF-100's for the R.C.A.F., AVRO Aircraft assumes an independent and experienced role in world aviation.

Already successfully test-flown for nine years, the new Company will direct the efforts of 10,000 experienced designers, engineers, technicians and skilled production workers. Assurance that AVRO Aircraft can meet the increasing demands of the Jet Age is confirmed by the proven development record of its extensive engineering staff, every member of which is constantly at work on aeronautical research and design for the future.



With management and policy unchanged, AVRO Aircraft continues to discharge its responsibility as one of the main industrial arms of the R.C.A.F. and through present and future projects reinforce and maintain Canada's air defence.

AVRO AIRCRAFT
MALTON
AVRO AIRCRAFT LIMITED

DEDICATED TO CANADA'S JETPOWERED LEADERS

ORENDA . . . *a new power in the Jet Age!*

Orenda Engines begins its corporate life with an established record of engineering and production achievement, with management and policies unchanged and with the same goal . . . leadership in the field of aerial propulsion.

From Orenda's design, development and production departments came the first all-Canadian jet engine to power the CF-100 and F-86 Sabres V and VI. Since September, 1952, the company has delivered over 1,500 Orendas. Expanded research facilities are now under construction to deal with the increasingly complex power requirements of the future.

The 6,000 people in the Orenda family are dedicated to designing, manufacturing, maintaining and servicing modern jet engines and other forms of aero power and to the building of a sound aircraft industry for the defence and development of Canada.

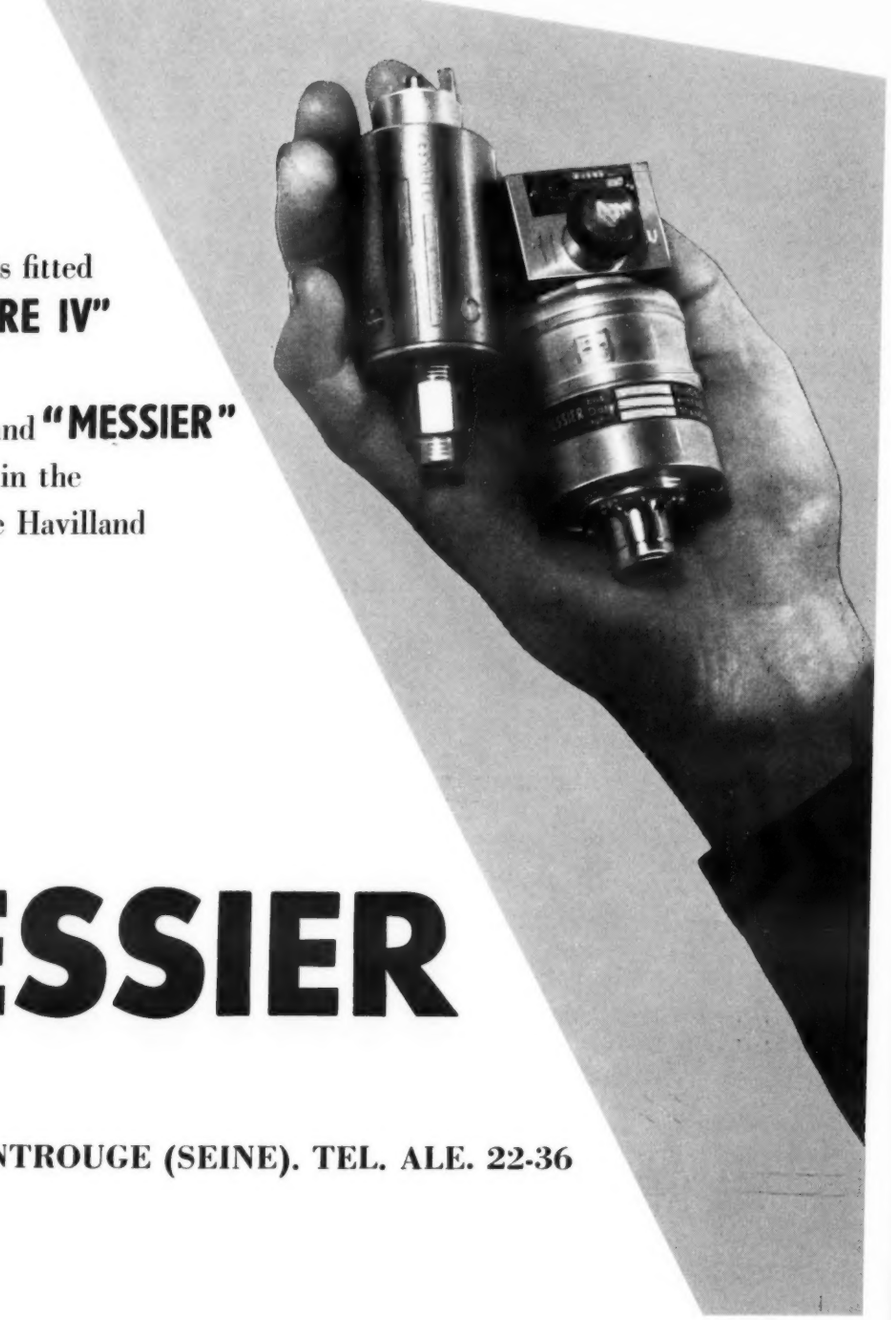
*ORENDA: Source of all power—*Iroquois*

ORENDA *ENGINES LIMITED*
MALTON

DEDICATED TO CANADA'S JETPOWERED LEADERSHIP IN THE AIR

The **MINISTOP** brake control

Weight of equipment:
2 lbs. per wheel



1952: Prototype built

1953: tests in aircraft

1954: the **"MINISTOP"** is fitted in the production **"MYSTÈRE IV"**

1955: the **"MINISTOP"** and **"MESSIER"** wheels and brakes are fitted in the Royal Swedish Air Force's de Havilland **"VENOM"**

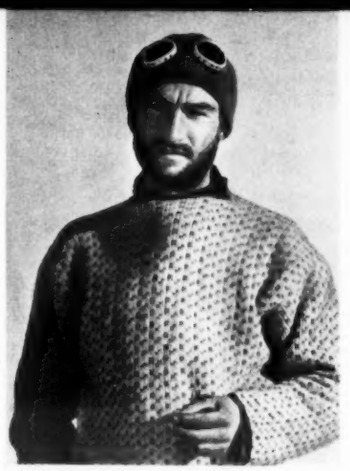
MESSIER

58, RUE FENELON - MONTROUGE (SEINE). TEL. ALE. 22-36

Rescue and Supply Work by Air in Greenland

BY ROBERT POMMIER, PARIS

Robert Pommier (35) is among the most enterprising of the younger generation of French Polar explorers.— 1946: Spitzbergen expedition (discovery of the island's highest mountain, Mount Newton). — 1947: Spitzbergen and Lapland (documentary film on Norwegian coal-mining on Spitzbergen). — 1948: Member of the Antarctic expedition aboard the French ship "Commandant Charcot". — 1949-1951: winter in Adelie Land. — 1952: crossed Greenland with a Franco-American party (Paul-Emile Victor and University of Georgetown). — With his personal experience of American expedition methods, Pommier is well qualified to give Interavia *readers a glimpse of Arctic rescue work.* *Editors.*



The author has taken part in three Arctic and two Antarctic expeditions during the past seven years ... When he visited Geneva he was clean-shaven.

In the course of the past seven years I have taken part in five Polar expeditions: two to Spitzbergen, two to Adelie Land, the French sector of the Antarctic, and one to Greenland. During these various expeditions I have witnessed a veritable technical revolution in the field of exploration. Since the end of World War II, traditions and routines have been completely overturned by the intensive use of caterpillar tractors as a means of transport across the snow, and of aircraft for rescue and supply work.

There were three of us on Spitzbergen in 1946. For weeks we dragged along our little sled containing the whole of our equipment. We did not even have dogs. Food was strictly rationed, and we lived almost at starvation level. We explored the mountainous region to the East of the archipelago and did not see an aircraft during the whole of the trip. Later, in Adelie Land, we had a small *Stinson* reconnaissance seaplane to cross the pack-ice. It was stowed on the narrow aft deck of the "Commander Charcot", and getting it on to the water was no mean enterprise. Take-off among the ice floes was always perilous. On his return the pilot told the captain of the channels open towards the coast.

It was soon after my return from Adelie Land that I took part in a Franco-American scientific expedition to Greenland. Our departure base was Thule, 880 miles from the Pole, where the Americans have built one of the largest air bases in the world. Our task was to cross the width of the ice cap as far as the East coast (and back), making seismic soundings and measuring the depth of the layer of ice covering Greenland. We had five Weasel caterpillar tractors, and the whole distance to be covered was about 1,800 miles. Supplies of fuel and food were dropped from the air at a number of predetermined points along the route. The tractor-plus-aircraft technique was perfected in 1947 by Paul-Emile Victor, who was the first to discover its efficacy, and by the members of the French Polar Expeditions who put it into execution, installing a permanent base in the middle of Greenland, which functioned for two years.

Glacier on the coast of Spitzbergen, visited twice by the author.

Accustomed as I was then to driving dog sleds, eating pemmican and suffering all kinds of privations, I was able to appreciate fully, during my last mission to Thule, the part played by aviation in the modern conquest of the Arctic and experience the great comfort now offered to travellers in these lonely wastes.

Some ten days before our arrival at Thule, a Grumman amphibian had landed on the ice cap, at the request of a scientist who wished to make observations there, and had been unable to get off again. The altitude of 6,500 ft. had greatly reduced the power of the engines. The five occupants, stranded in a desert of snow nearly 200 miles from Thule, had built a small hut next to the aircraft with such materials as came to hand. They were living there in complete isolation and beginning to wonder how they would ever get back to the coast, from where an aircraft came every day to drop them food, building material, magazines and mail.

Polar crossroads

During the time we were preparing our expedition I had the opportunity of taking part in a rescue flight to the group, on board a B-29. I was installed with an observer in the forward post and watched beneath us the crevasses of a glacier which rose in broad steps towards the ice cap. I knew that a few days later we should have to climb this vast staircase with our tractors. Shortly afterwards we reached the snow desert. After three quarters of an hour's flying towards the East my companion pointed to the ground. At first I could see nothing, then suddenly I made out some minute black specks among the immense wastes: the stranded party's camp. Our aircraft went down lower and lower in large circles. For an hour it passed repeatedly over the camp, dropping equipment suspended from small red parachutes like poppies. All this time our radio operator was in R/T communication with the captain of the amphibian. All was well below. The men were installed comfortably in their hut. They had an oil heater and a butane cooking stove. The amphibian lay there alongside, undamaged but incapable of getting into the air. A straight furrow in the snow showed where it had tried in vain to take off. The many footmarks all around suggested that the favourite relaxation of these Robinson Crusoes of the snow was walking, despite the severity of the countryside.

Strange as it may seem, these men daily received letters posted forty-eight hours earlier in the United States. They did their cooking by gas and were in no kind of danger. However, they could not move away and lived in the hope of being evacuated. For some time the experts were puzzled as to how this could be accomplished. Return by land would have been exhausting and particularly dangerous, as the glacier we had flown over formed a barrier to the East of Thule.

Flying low over Greenland's 6,500-ft. central plateau demands considerable skill in the pilots of the supply aircraft. – Left, the dropping zone marked out in the snow by a caterpillar tractor. It shows the pilot where he should drop his cargo.

Finally, the amphibian was able to take off by using JATO rockets underneath the wings. It had previously been lightened of all unnecessary equipment, such as seats, radio etc. These precious objects were later recovered by a convoy of tractors.

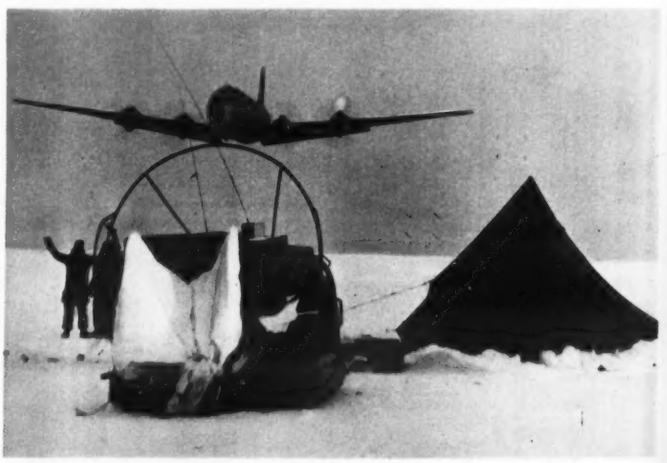
Because of its altitude, the Greenland ice cap presents a special problem in rescue work, that has not yet been entirely solved. During the war an aircraft crashed on the inland ice. Another landed alongside it, but could not take off again. Several others were sent successively to the same spot and all became stranded one after the other. It was a considerable operation to rescue the twenty or more airmen who were suffering from cold and hunger.

After my return to Thule from the flight in the rescue aircraft, I made reconnaissance flights by helicopter over the Thule glacier, under the instructions of Robert Guillard who was to command our convoy. Our job was to reconnoitre a route for the tractors across a labyrinth of crevasses. Before departure, red flags were fixed to the helicopter's skids. When we came to what we thought were suitable spots we asked the pilot to set his machine down on the snow or ice. He stayed in his seat, with the engine running, while we jumped out and marked the spot with one of the red flags. Back in the cabin we gave the signal and the helicopter set off again.

On one of these flights the machine I was in turned over just after take-off and broke up completely. When the accident happened, I had not yet fastened my safety belt (a bad mistake) and I felt myself sailing through the plastic cupola like a dancer through a paper hoop. But neither the pilot, who was attached head down, nor I were injured. We were 50 miles from Thule. My companion was wearing town shoes and a cloth suit. He was very

To reduce speed the DC-4 lowers flaps and undercarriage, before dropping jerricans for the expedition from a few feet above ground.

An American mail aircraft from the U.S. Air Force base at Thule arriving over the French expedition's camp on the East coast of Greenland.



cold. But fortunately other helicopters came and picked us up three quarters of an hour later.

It should be added, however, that accidents in Greenland, as elsewhere in the Arctic, are rare, and are no more serious than those, for example, in the heart of the Alps. It can be foreseen that in the years to come the ice cap will be increasingly furrowed with routes marked out for tractors. Finally, bases established at convenient points will enable rescue work to be carried out rapidly and efficiently.

The next week we followed in our tractors the route marked out across the glacier. At one spot the usual red flag was replaced by a twisted metal carcass.

The first supplies were dropped from the air at the edge of the ice cap, and I had my first experience of an astonishing spectacle which was later to become a familiar event.

The dropping zone is first marked out by a tractor, which traces two straight lines in the fresh snow with its caterpillar track. This shows the aircraft pilot where and in what direction he should drop his supplies. The air base radios through the aircraft's departure time. The men on the ground wait and watch the sky. A black speck appears in the West, and soon they can make out the silhouette of a twin-engined aircraft. It makes a first run over the snow at less than 30 ft. altitude. This manœuvre needs very great mastery on the part of the pilot. While the aircraft is making a half turn at a distance and getting back into position, radio communication is established.

"Hallo . . . we're going to drop the Jerricans of gas first."

"O.K."

The aircraft comes back, seeming to dive down on to the convoy, passes within a few yards of the tractors and suddenly a whole chain of petrol cans drops out of the open

Weather observation post of the French Polar expedition.

cabin door and goes rolling and bounding into the snow.

All supplies are dropped in this way during some ten runs. Parachuting, from higher altitudes of course, is used only for fragile material (radio equipment, scientific instruments) or dangerous goods (explosives).

Before finally leaving, the aircraft drops a sack of mail. The men rush for it, tear open

The U.S. Navy fits its Arctic supply transports with skis.

Wreck of a R4D-5 used by the U.S. Navy for tests under Arctic conditions.

the envelopes and immediately read their letters. But the bulk of the work still remains to be done. A tractor towing a sled is driven round and the hundreds of scattered cases and containers collected up. The Jerricans sometimes come out of the adventure somwhat dented, but it is rare that they burst.

When everything has been carefully stowed away and the vehicles have been refuelled, the tractors move off in Indian file, covering several stages.

In the middle of Greenland we were supplied by a DC-4 which flew over us with flaps and undercarriage lowered to reduce speed. The

On a reconnaissance flight over the Greenland icecap the author's helicopter nosed over. He was unhurt, in spite of being hurled through the plastic cupola.

food dropped included fresh fruit and vegetables, as well as a huge turkey, which we were unable to cook as we had no dish big enough.

When the sky was overcast the aircraft sometimes was unable to find our convoy and turned back. We then had to stay longer than usual in the same place. Sometimes we lit fires with engine oil which gave off black smoke and thus helped the aircraft to locate us.

On this expedition we crossed the whole of Greenland without the slightest feeling of being isolated. If we needed anything we asked for it by radio, and delivery was made within forty-eight hours. From time to time, as I was driving my tractor along, smoking a cigarette, with my feet kept warm by the engine, I thought of the Polar explorers of twenty years ago, crossing Greenland with very great fatigue, running behind their dog sleds and eating their meagre rations in their tent at the end of the day. These men knew what human adventure was. Today we have entered the period of great technical adventure. At the Pole, as elsewhere, the aircraft has abolished distance and wiped out solitude. All we have to do now is adapt ourselves completely to the new methods and above all, when we set out on a trip, not forget to take with us a big pot . . to cook the turkey!

The conquerors of the North Pole: the airship *Norge*, carrying Amundsen and Nobile, crossed the North Pole on May 12th, 1926.

Brief History of Polar Flying

BY CHARLES DOLLFUS, CURATOR, AIR MUSEUM, PARIS

When in the middle of the last century men set out to conquer the Pole, their only means of transport was their own legs, with sleds laboriously drawn by semi-domesticated dogs to carry their meagre equipment. How many times must these early explorers, at odds with the treachery of nature at its most hostile, have longed like Icarus for wings.

Yet there was an air vehicle in existence, the balloon, which had already proved its ability to carry men quite easily over relatively long distances. It was inevitable that it should be called upon to carry a party of explorers across the Polar ice. All that was necessary was to take the old balloon designed for over-land trips and adapt it to its new duties. The Polar balloon had to cover longer distances than any balloon had yet done, remaining in the air for weeks at a time. Hence it had to have a particularly gas-tight envelope and to be of exceptionally large dimensions, since it would have to carry not only the explorers and their equipment, but also a considerable weight of ballast to ensure that the pilot could manœuvre it adequately. Finally, it could not be left to the mercy of the winds, so it was equipped with a system of sails and guide ropes to keep it, within a certain measure, under the control of its crew.

No sooner had the idea been expressed than it was put into practice in a number of projects, the earliest being that of the aeronaut *Sivel* who designed a balloon with particularly ingenious "Polar innovations" (1872).

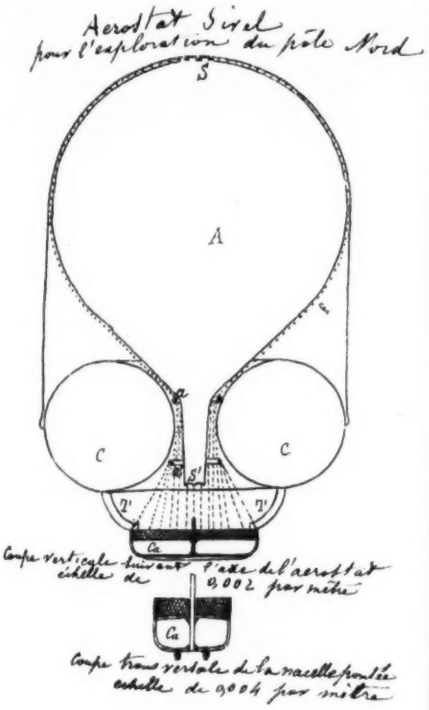
A curious fact in connection with these projects is that there were more balloonists who dreamed of becoming Polar explorers than seasoned explorers who thought of becoming Polar balloonists.

On July 11th, 1897, a balloon that had been built in France to a Swedish design and then taken to Spitzbergen, took off on the first adventure of this kind. This was the *Oernen*, manned by *Salomon Auguste Andrée, Nils Strindberg* and *K. Fraenkel*.

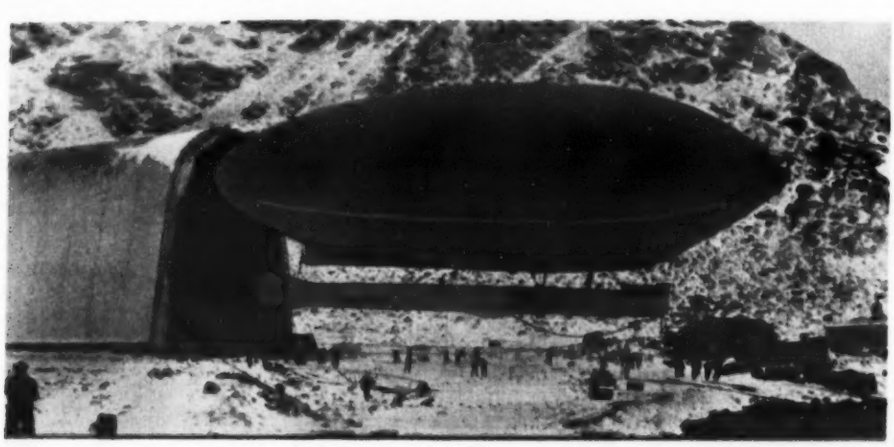
The venture ended in tragedy, the first in the annals of Polar flying. The accident was reconstructed thirty-three years later when a ship found the bodies of the three heroes, on White Island, not far from Spitzbergen, along with the equipment they had used in their attempt to get back. The latter included photographic plates, which were later successfully developed.

The balloon was abandoned as a Polar vehicle and replaced by the airship. The American explorer *Wellman* made three unsuccessful attempts, in 1906, 1907 and 1909, and Count Zeppelin prepared a detailed project for a trip to the North Pole.

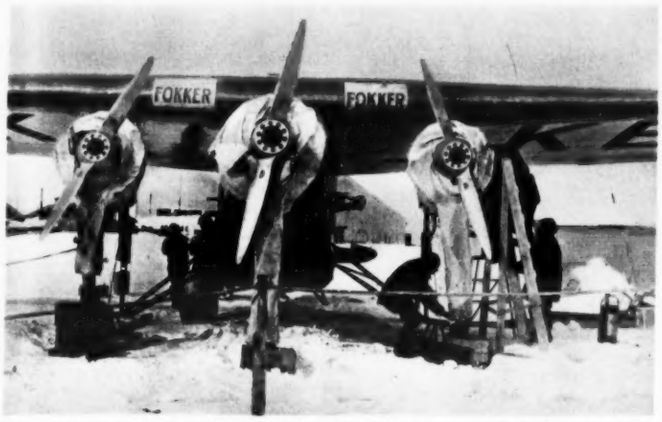
Sivel's project for a Polar balloon (original document of 1872).



Wellman's airship *America* leaving its hangar on Spitzbergen (1907).



Inflatable raft of the airship *Italia*, which enabled landings to be made on the pack-ice.



The conquerors of the North Pole. Commander Byrd's three-engined Fokker flew over the North Pole on May 9th, 1926.

Wilkins and Eielson's Lockheed *Vega*, which crossed the Arctic on April 15th, 1928, from Point Barrow, Alaska, to Doedmansoeira, Spitzbergen, covering 2,175 miles in 20 flying hours.

Then there came the heavier-than-air machine, with which a number of successful expeditions were made between 1925 and 1929. For example, the Swiss pilot *Mittelholzer* made a very interesting geographical study in the neighbourhood of Spitzbergen in a Junkers monoplane.

In May 1925, *Roald Amundsen,* the greatest of all Polar explorers, accompanied by five others, including *Riiser Larsen, Dietrichson* and the American *Ellsworth,* set out to fly over the Pole in two Dornier *Wal* seaplanes. The attempt failed, though there was no loss of life. The two seaplanes were forced down on to the ice, but the expedition was able to return in one of them.

On May 9th, 1926, the North Pole was flown over for the first time by Commander (now Admiral) *Byrd,* on board a three-engined Fokker F.VIII piloted by *Floyd Bennett.*

On May 12th the same year, the Italian airship *Norge* also flew over the North Pole, carrying *Amundsen, Ellsworth, Riiser Larsen, Malmgren* and *Nobile.*

Amundsen, who had reached the South Pole eleven years earlier, was the first man to have been at both Poles.

Other successful attempts were made during the years following, and there were other failures. On April 15th, 1928, the Australian explorer *Wilkins* crossed the Arctic in a Lockheed *Vega* piloted by *Ben Eielson.*

On May 23rd, 1929, General Nobile flew over the Pole in the airship *Italia* manned by an Italian crew and accompanied by the Czech *Behounek* and the Swede *Malmgren,* but was

Roald Amundsen, the greatest of all Polar explorers.

forced down on to the ice by bad weather. The forward cabin containing Nobile and eight of his companions broke off, while the envelope and the rest of the crew disappeared. The disaster united the world in offers of help. Amundsen, Dietrichson, Guilbaud and de Cuverville dashed off to rescue Nobile on board a French seaplane. The machine and its occupants vanished into the Far North, never to return. Nobile and six of his companions were rescued by the Russian icebreaker "Krassin".

The heroic age of the exploration of the North Pole by air was over; sport was now succeeded by science.

In 1937 the Soviet Union began its scientific expeditions, the prelude to the establishment of its present trans-Arctic air route. Parties of scientists were taken by air to the neighbourhood of the Pole and returned by air again on completing their missions.

Two remarkable exploits were accomplished about this time by Russian flyers in ANT.25 single-engined aircraft. In June 1937 the pilot *Chkalov* and two companions made the first flight from Europe to America via the North Pole (5,320 miles between Moscow and Portland, Oregon). In July, the pilot *Gromov* and two companions set up a world distance record (6,300 miles) by flying over the Pole from Moscow to San Jacinto, near Los Angeles.

By 1950 Arctic flying had become an everyday affair (at any rate in the military field), and we find an aircraft arriving at the appointed time in Oslo after a flight from Alaska via the North Pole. It carried the well-known pilot *Bernt Balchen,* who had come to accept an invitation from his native country.

The aerial exploration of the Antarctic also has its history. The pioneers are again *Wilkins* and *Eielson,* who used two small aircraft with skis.

Then, in 1928, Admiral Byrd, armed with powerful equipment including four aircraft, set out on a campaign of exploration which lasted more than a year. On November 29th, 1929, Byrd, Balchen and MacKinley flew over the South Pole for the first time, in a three-engined Fokker, after crossing a 14,990-ft. mountain.

Admiral Byrd, always with an organization complete in every detail, has since continued his explorations and discoveries.

In 1935, Lincoln Ellsworth and Balchen were the first to cross the whole of the Antarctic continent in a single flight, from Graham Land to Ross Sea.

And now the Arctic is being opened up to commercial aviation.

Two of the aircraft on one of Byrd's expeditions to the South Pole.

Air Navigation in the Arctic

That navigation in the North Polar regions requires special instruments, special maps and specially trained navigators is well-known. The methods used are no secret, though they are so complicated that only the expert can fully understand them. To give readers at any rate a rough idea of this basic problem in any form of Polar flying, the Editors have asked three experts—one military and two members of Scandinavian Airlines System—for their help.

*

Colonel Pierre M. Gallois, of the French Air Staff, sees the problem as follows:

"Both nature and man have combined to make Polar air navigation complicated. In the Arctic where land, sea and ice are so confused that the eye cannot determine where one finishes and another begins, there is the added difficulty of the unreliability of the magnetic reference point on which the navigator relies in other latitudes. And man, absorbed by the activities he has developed over thousands of years in more clement regions, had long neglected the ocean of the far north and the continent of the far south. Normal cartography was limited to reproducing the inhabited regions and movements following, by and large, the parallels, and ignored the disinherited regions of the globe, substituting a cylinder for the sphere. From being at one time purely Mediterranean, the world has taken twenty centuries to become more or less cylindrical, with the two polar caps missing. Now the aircraft is beginning to give it back its true, complete form.

*

"In summer the Arctic seas are most often covered with fog, though this does not form a serious hazard in present conditions of flight. When the surface is masked in this way, vertical radar of the H2S or HSX type can sometimes give the navigator the outlines of the land or ice. By observing 'landmarks', such as crevasses, on the radar screen, wind influence can be calculated.

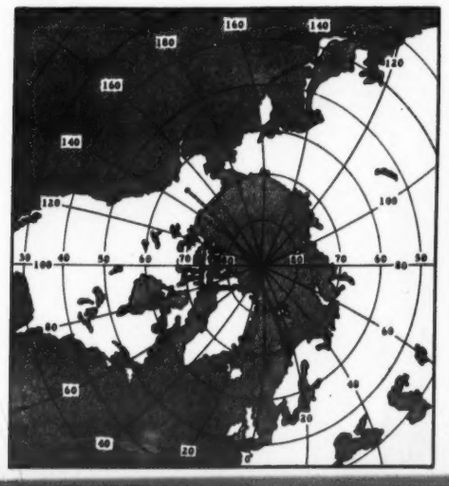
"The variations in terrestrial magnetism in the Arctic are beginning to be known. Horizontal component H of the terrestrial magnetic field diminishes with increasing latitude. From 0.15 gauss (or oersted) at Moscow, it drops to the neighbourhood of 0.03 gauss near the geographic Pole. The gyro-magnetic and Flux-Gate compasses developed during World War II continue to give valid readings despite reduction in this horizontal component and still function at values approaching 0.03 gauss. But below this figure these two instruments are also unreliable. Ordinary magnetic compasses have been found to be useless within a wide radius of the magnetic Pole. The position of the latter has been the subject of some controversy. Amundsen placed it at approximately 70° North and 95° West. Later calculations showed it to be several hundred miles from this point. Since then, it has been found that certain natural phenomena, such as the structure of the terrain and the existence of large mineral deposits, can considerably affect observation of terrestrial magnetism so that the magnetic charts need constant modification. If the magnetic compass is used, very careful attention must be given to its compensation, as the horizontal component of the magnetic field is very weak in these zones.

"The usual maps giving the values of magnetic variation should be supplemented by maps showing lines joining equal horizontal components and lines joining equal dip of the compass needle. Another difficulty: diurnal changes in variation, negligible elsewhere, are very important in the Polar region, and tables are needed to ascertain them. Every eleven years, corresponding to the sun-spot cycle, there is a critical period of magnetic disturbances. At approximately latitude 80° North the maximum changes recorded could temporarily modify a place's normal variation by as much as 7 to 10°.

"In the field of radio navigation and communications, Russian experts began the study of the conditions of propagation of electromagnetic waves in Arctic regions even before World War II. Range of medium and low frequencies is markedly better than in other latitudes. On the other hand, for high frequencies, where propagation of waves depends on their reflection from the ionosphere layers, communication may be impossible. There are also considerable seasonal variations due to the long Polar night, and it may happen that the H.F. band becomes unutilizable. A kind of international organization for transmissions in the Arctic would be useful, to make the necessary investigations and keep operators informed of the most suitable frequency bands as determined by the evolution in the ionospheric, meteorological and magnetic solar situation (sunspots).

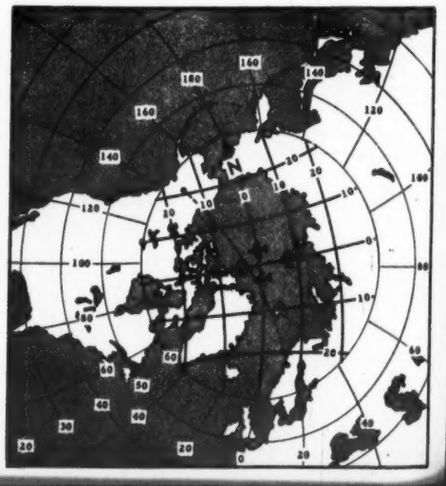
"All these problems and many others have been studied these last few years by both military and commercial aviation experts. While the fact that the Soviet world is closed to international commercial aviation has restricted the value of trans-Arctic air routes and deflected air traffic between the Old and New Worlds to the North Atlantic and the Western

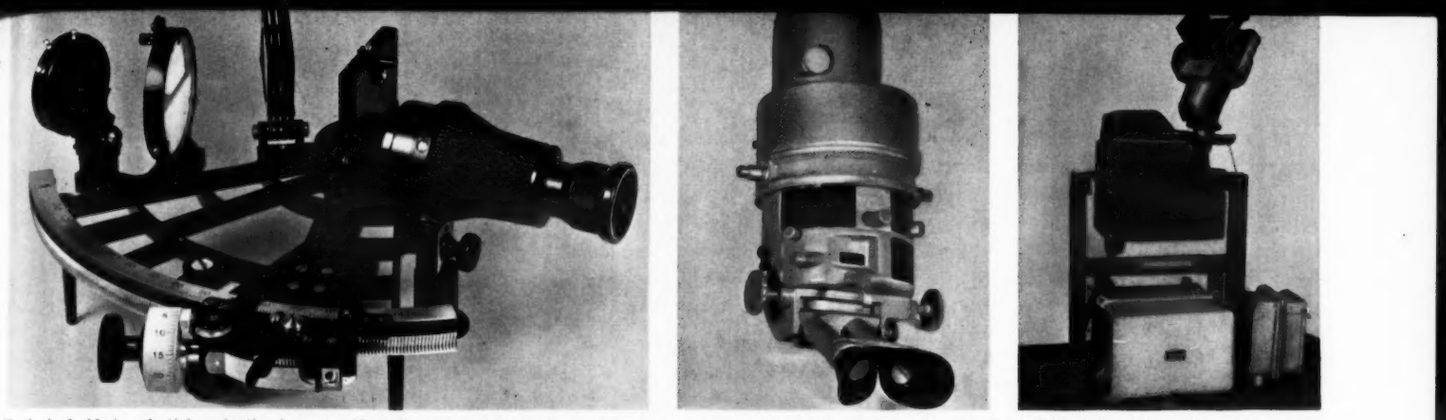
At the geographical North Pole the meridians converge at such a sharp angle that navigation by true bearings, e. g., on the Bodö-Fairbanks Great Circle route (thick line) would necessitate a 1° change in heading every 4 to 5 minutes.



Only a stereographic projection of the Arctic on a plane tangential to the geographical North Pole (Q) solves the problem; the source of projection is the South Pole (Q'). Circles on the map correspond to circles on the globe; the meridians become radial lines.

The Greenwich grid system: headings given in grid degrees remain constant throughout the flight on a Great Circle route.





Technical aids to celestial navigation have considerably improved during the past twenty years: from the simple marine sextant (made by C. Plath in 1936) to the periscope sextant (Askania; 1939; *centre*) and nadir gyroscopic sextant (Askania; 1944; *right*).

portion of the Eurasian land mass, military rivalry between the two *blocs* has mobilized the Arctic air space and shores. However, with Scandinavian Airlines System's Douglas DC-6B flights, first experimental, then regular, commercial aviation has begun to enter the field where hitherto only the military have been involved.

"A special mapping system has also had to be created. With the normal projections the navigator would meet two particular difficulties in Arctic regions. Near the geographic Pole the meridians converge at too acute an angle for direction to be measured with their aid, and, once at the Pole, the navigator finds that all directions are indistinguishably South . . .

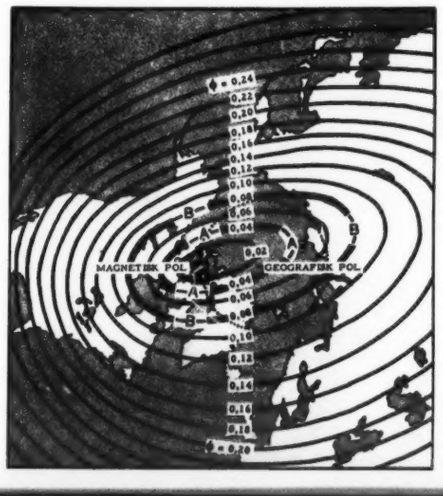
"It is already several years since *Wing Commander Maclure,* one of the navigators in the *Aries,* designed a mapping system adapted to transpolar flights. Up to latitude 75° North, the *Aries* navigators worked on Mercator's projection. Beyond, they used a Polar stereographic projection, a geometric perspective projection. The plane of projection is a tangent to the sphere, in this case at the North Pole, and the source of projection is diametrically opposite. The projection is orthomorphic. Meridians are represented by converging straight lines each forming an angle with the next equivalent to their difference in longitude. Parallels become concentric circles. It will be seen that near the Pole, i. e., in the centre of the map, there is no difference between a straight line drawn on the map and an arc of a great circle. It was on this cartographic presentation of the Arctic grid that Wing Commander Maclure designed the Greenwich grid system successfully used on the first flights by the Lancaster *Aries*. The *Aries* flights, the first of which began two days after the end of the war, proved the value of this change in cartographic reference system. On its frequent flights across the Arctic, the U.S. Air Force has long been using a Greenwich grid. S.A.S.'s aircraft, though they rarely fly further North than latitude 70°, also use the Grid Navigation System.

"In the present state of navigation aids, it is still celestial observations which provide the basic reliable elements for navigation. By preparing observations in advance, based on the most suitably placed heavenly bodies, and by using the new sextant which reduces the difficulties of daytime observations during the bad seasons of the year, the navigator has sufficient data at his disposition to follow his itinerary correctly. Looking back at Ellsworth's Antarctic flight, it will be seen that, even twenty years later, the principles of navigation in Polar regions have not changed, though the technical aids to celestial navigation have progressed."

In the view of K. Hagerup, Vice-President Operations of Scandinavian Airlines System, the main difficulty in Arctic air navigation is caused by the convergence of the meridians towards the geographical North Pole and by the convergence of the isogonic lines towards both the magnetic and the geographical Poles. In high Northern latitudes the magnetic compass becomes useless.

"During flight near the geographic Pole, any course (except North-South) will make the aircraft cut across a number of meridians in rapid succession at ever changing angles. Even a short distance along the charted route will frequently mean a change of many degrees in longitude. If on an ordinary map we trace the route followed by *Captain Blair* in a F-51 *Mustang* fighter from Bardufoss, Norway, to Fairbanks a few years ago, we find that he first steers almost due North, changes to a westerly course when passing by the Pole, and then to a southerly course. The rate of change was about *one degree every four minutes* during his 10 hr. 27 min. flight.

Horizontal components of the magnetic field (in oersted or gauss) in the Northern hemisphere: A = limit of application of the magnetic compass; B = limit of reliability; dotted circle = movement of magnetic North Pole in 960 years.



"Using a stereographic projection of the Arctic, a given meridian is chosen as reference line, thus forming the basis of a grid system. Two grid systems are in common use today, one American, the other British. The American system employs the Greenwich meridian as the master meridian (Grid North) and reckons direction from Greenwich past the North Pole and on along the 180th meridian. If a course line for a flight near the North Pole is to be traced under this system, all that need be done is to measure the course line's angle to the master meridian. The course angle is then expressed in grid degrees, and does not change along the whole of the Great Circle flight. In this way the navigator becomes independent of the convergence of the meridians.

"The other difficulty is that the magnetic North Pole is not an exact point but must be defined as the area in which the horizontal component of the earth's magnetic force is zero, the entire terrestrial magnetic field being vertical. A freely movable compass needle will here point towards the centre of the globe, and the function of the compass as a directional instrument has thus terminated. An ordinary magnetic compass does not function properly within 1,000 nautical miles of the magnetic North Pole.

"It is therefore necessary to use other course-giving instruments without dependence upon the earth's magnetic field, if flights in the Arctic are to be performed as routine. These instruments are the directional gyro, the astro compass, and radar.

"The *directional gyro* takes the place of the magnet. Its rotor disc, which spins very rapidly about its gimbal-mounted horizontal axis, maintains its direction in space (i. e., in relation to the fixed stars), in principle undisturbed for ever[1]. But as the earth also rotates about its axis, the meridians change their angle

[1] The directional gyro is not a space gyro, but is "tied" by a precession mechanism in such a way that the rotor's axis of rotation is maintained in a plane at right angles to the outer gimbal ring axis.

to the rotor disc plane, i.e., the directional gyro is subjected to 'apparent' drift. 'Apparent' drift has its maximum value at the Poles, where the meridians intersect the earth's axis at right angles, and where it is a full 360° a day, or 15° per hour. At the Equator, where the meridians run parallel to the earth's axis, 'apparent' drift falls to zero, and between these two extremes it can be calculated from the formula: *hourly drift equals 15° times sine of the latitude*. The directional gyro drifts to the right in the Northern hemisphere. After two hours' flight at latitude 30° N, it will no longer indicate the value set at take-off, e.g., North, but 15° NNE, as sin 30° equals 0.5. In addition to the 'apparent' drift, there is the so-called random drift caused by mechanical disturbances, such as friction, which may also amount to several degrees per hour.

"At very short notice, *Bendix Aviation Corp.* in the U.S.A. constructed a directional gyro for S.A.S. with a random drift of about 1 degree only, immediately before the S.A.S. Arctic flights. Furthermore, this gyro was modified in such a way that it could be connected up with the autopilot. In the usual set-up the autopilot receives signals from a magnetic compass, and if no connection to a gyro system can be made, the aircraft must be manually flown in the neighbourhood of the magnetic North Pole. In an emergency S.A.S. could fall back on the ordinary directional gyros. Bendix special gyro, which was not made known to the public until some time after the first two Arctic flights, was of considerable benefit during these flights. The instrument was christened 'Riiser Viking' after General Hjalmar Riiser-Larsen.

"If the random drift of the gyro is small and continuous, flight on a constant gyro course (in still air) would result in flight along the arc of a circle with an hourly change of heading of 15 degrees times the sine of the latitude. The best way of correcting this tendency is to make a heading check every half-hour with the astro compass[2], to compare this with the directional gyro heading, and to change the course towards the left by the number of degrees corresponding to the 'apparent' drift since the last heading check. Thus, the track flown appears as a series of circle segments, and the distance becomes somewhat longer than the Great Circle distance between starting and landing points. The average track, however, coincides with the desired grid course.

*

"Two navigators work together on S.A.S.'s Arctic flights. One handles all chart work at the navigation table. He calculates winds, positions, drift and speed, and gives the pilot the grid courses to be steered. The other navigator checks the gyro with the astro compass, makes a graph of the gyro's drift and also shoots the stars, the moon or the sun with his sextant, to calculate the aircraft's position.

"The best navigational aid in the Arctic is still celestial navigation based upon fixes of the stars. Especially in the winter months, conditions for celestial navigation are exceptional, as the stars are visible 24 hours a day. In the summer months the sun is continuously above the horizon, and the moon or the brighter planets may also be used when they are above the horizon. The difficult time for arctic navigation comes around the spring and autumn equinoxes when the twilight period is the longest. However, the Americans have constructed an instrument for use in these twilight periods which uses the phenomenon that light from the sky is polarized perpendicularly to the bearing of the sun. Its name is '*Pfund's Polarized Sky Compass*,' and it will give the bearing of the sun even when it is below the horizon or hidden behind a thin cloud layer.

*

"After astro navigation, *radar* is also an important navigational aid in the Arctic, at least for military aircraft. Instead of using radar for map reading, however, as is normally the case at lower latitudes, radar in the Arctic is employed to take lateral drifts due to wind and to compute ground speed. This is done with the help of outstanding objects which are followed on the radar screen. The question whether this equipment will in time be employed on ordinary civilian aircraft is not yet settled, as it is heavy and expensive. S.A.S. did not use radar on its flights.

"So far as radio communications are concerned, radio conditions are not quite adequate, and 'blackouts' lasting up to two days may be encountered. The Ionospheric Institute in Washington, however, is able to forecast these well in advance. Even during a blackout an aircraft may contact nearby radio stations, but during a magnetic storm these will not be able to relay messages to very remote stations.

"The greatest radio disturbances do not appear at the magnetic Pole, but in a circular belt around it, named the Aurora Zone. With the present radio network there will be one or two days each month when weather forecasts from the Arctic will not get through. Long distance navigational aids like 'Consol' and 'Loran', which today are only operating south of 70° north, are also influenced by these disturbances.

"To ensure adequate regularity of civil flying in the Arctic, a certain extension of the radio network must be regarded as essential. A flight may not start if no weather observations from the Arctic stations can come through in advance. At other times radio conditions may be extremely good in these areas. For example, during S.A.S.'s first Arctic flight, the crew got radio contact with Kastrup, Copenhagen immediately after take-off from Thule. Later, over Greenland's East coast, the captain sent a greeting to Kastrup. His brother was then sitting in another S.A.S. aircraft over Lydda (Israel) and heard the message."

*

Einar Sverre Pedersen, S.A.S. Research Navigator, adds an account of some of his personal experiences to these remarks:

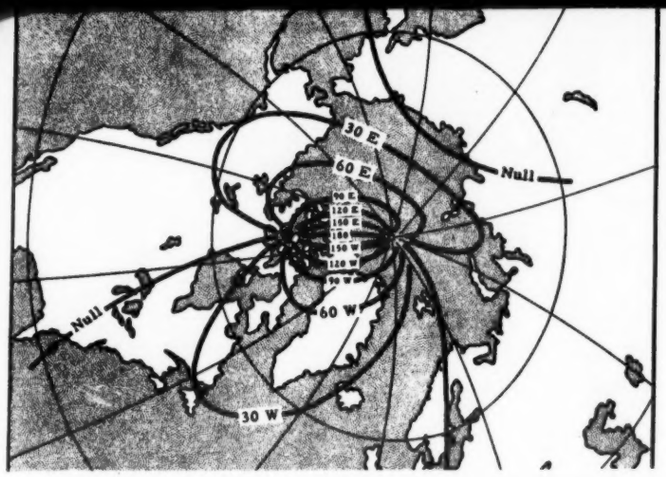
"In order to get the necessary experience in grid flight planning and actual grid flying, I made a series of grid flights on magnetic compass across the North Atlantic simulating Arctic conditions, and I soon found out that grid flight planning and single grid heading flying offered great advantages even on the North Atlantic route.

"During the period 1952 to 1954 a whole series of trans-Arctic and trans-Atlantic grid flights were carried out by S.A.S. on the *Polar Path Gyro*. The following five flights each represent a characteristic stage in the development of the Polar Path Gyro System.

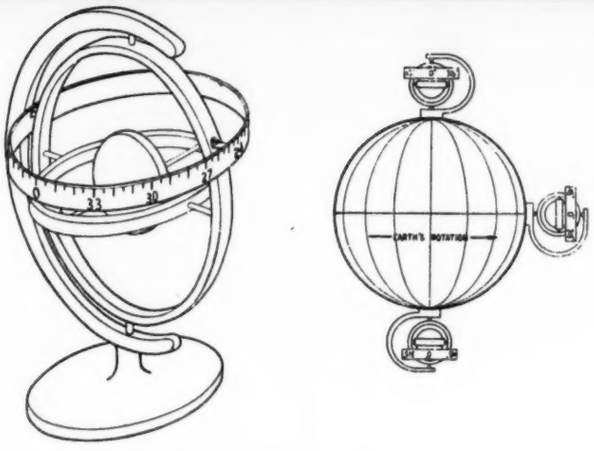
"*Los Angeles-Thule-Copenhagen:* This first trans-Arctic flight by S.A.S. was made in November 1952, and the Polar leg was flown in total darkness. To be able to check the Polar Path Gyro right from the start in Los Angeles the gyro was left uncalibrated and consequently the drift due to the earth's rotation was 15 deg. sin latitude per hour to the right. A gyrograph was carried from Los Angeles to Edmonton giving a random drift of only 1 deg. per hour. The leg from Edmonton to Thule was flown with the Polar Path Gyro controlling the autopilot, and on this flight too the random drift was about 1 deg. per hour. From Thule to Copenhagen the aircraft was again controlled by the Polar Path Gyro with the same result. The drift caused by the rotation of the earth averaged 13 deg. per hour to the right, as precomputed. The next step was now to calibrate the gyro for a special latitude to eliminate the 'apparent' drift. This was done prior to our trans-Arctic flight from Oslo to Tokyo.

"*Gander-Prestwick via Great Circle:* To be quite sure that the Polar Path Gyro worked satisfactorily, it was installed on the aircraft selected for the trans-Arctic flight when the aircraft was in New York, and together with *Mr. Hembrough* from the Bendix factory I

[2] The astro compass, designed to provide a mechanical means of solving the "spherical triangle of position" (cf. article by A. Bastide elsewhere in this issue), can also be used for taking the true heading of the aircraft and the true bearing of a distant object.



In wide areas of the Arctic the magnetic compass needle points to anything but North. Here the lines of equal magnetic variation (isogonic lines) for the Arctic region in 1935. The isogonic line for 30° W touches Newfoundland and Iceland.



Principle of a directional gyro, which replaces the magnetic needle in the Polar regions and provides a reference system which maintains its direction in space, i. e., in relation to the fixed stars. Because of the earth's rotation the directional gyro has an "apparent" drift of 15 degrees per hour to the right at the North Pole, and 15 degrees to the left at the South Pole. At the equator it is zero, and at medium latitudes it is determined by the formula: drift = 15°/hr. times the sine of the latitude. The axis of the directional gyro remains horizontal at all geographical latitudes, or, more accurately, in a plane at right angles to the outer gimbal ring axis.

made a single grid heading flight from Gander to Prestwick. This was probably the first single grid heading flight ever made by a commercial aircraft on gyro across the North Atlantic. Our gyro was calibrated for 0 drift at 75 deg. N. So we had about 2 deg. drift per hour, our mean latitude being 52 deg. N. This drift was compensated for in the computation of the grid heading. The test flight convinced me that single grid heading flying on gyro is the only sensible way to fly a modern aircraft across the Atlantic as long as saving of flight time is one of the main objects of navigation.

"Oslo-Thule-Anchorage-Shemya-Tokyo:

This flight took place in May 1953 and was the first commercial flight via the Northwest Passage to the Far East. From Oslo to Thule the Polar Path Gyro calibrated for 75 deg. N. worked perfectly, controlling the aircraft. Average drift was 1.5 deg. per hour to the right. From Thule to Fairbanks the drift was 0, a result which showed that the calibration was perfect. Polar navigation certainly becomes quite pleasant when you work with a gyro like the Polar Path. Returning from Tokyo I suggested to S.A.S. Operations that all DC-6Bs should have the Polar Path Gyro as standard equipment and I was convinced that we could save between 5 and 10 minutes on each Atlantic crossing only by keeping exact heading. But to make the Polar Path Gyro System really valuable for both Arctic and Atlantic flights, latitude integration had to be introduced in the system, to enable the navigator to compensate for drift at *any* latitude.

"New York-Prestwick via rhumb line direct:

The Bendix company, cooperative as always, made a latitude integration arrangement available for us, and this is now incorporated in the Polar Path Gyro System. In October 1953 I was able to test-fly this new Polar Path Gyro System across the Atlantic from New York to Prestwick. One of the main objections to installing the Polar Path Gyro on all our DC-6Bs flying the Atlantic route had been the fact that we could fly on gyro only when the track was a Great Circle or a composite route consisting of two or more Great Circles. However, very often the rhumb line is the shortest flight time route, specially between New York and Prestwick, and a rhumb line could not be flown on a gyro compensated only for 'apparent' drift without changing heading very often. The situation would be something similar to flying a Great Circle on a magnetic compass.

"Through the latitude integration arrangement it now became possible, by making a certain correction for heading and ground speed taken from a special graph and applying it to the latitude drift correction, to fly true heading on Polar Path Gyro without having to change heading regularly. This was *automatically* taken care of by the latitude integration device. Consequently nothing now prevented the navigator from flying a single heading, based on a rhumb line track, on Polar Path Gyro. In such a case as this the Mercator chart of the Atlantic would be the most practical chart for plotting.

"The test flight from New York happened to be exactly such a case where a rhumb line is the shortest flight time route. By taking out the proper rhumb line correction and latitude drift correction, adding them and setting the resulting correction on the latitude correction scale, the aircraft was brought on to a true heading which would make good the desired rhumb line track. The aircraft was controlled by the Polar Path Gyro through the autopilot and through the latitude integration unit. By means of latitude integration and rhumb line correction it is now possible to fly all over the globe, either grid headings or true headings, on Polar Path Gyro. For an airline in global operation this means that even if the Polar Path Gyro System is installed primarily for use on Arctic routes where the magnetic compass is not reliable or does not work at all, it may also be utilized on other routes like the North Atlantic with great economic advantage to the operator.

"Oslo-Bodö-Fairbanks, via the Geographical North Pole:

In May 1954 the Polar Path Gyro System went through the final test when *Leif Viking* flew from Bodö to Fairbanks via the North Pole proper. I decided to fly on Polar Path Gyro right from the take-off and thereby get some additional time to rate the Polar Path Gyro before we entered into the area where the horizontal component of the earth's magnetic field is too weak to give the compass needle the necessary sense of direction. When we finally entered this area the Polar Path Gyro was very well trimmed. Through the latitude integration we had no 'apparent' drift and the random drift was less than 1 deg. per hour. *For about 2,800 nautical miles of mostly uncharted ocean, without any radio aids whatsoever, the Polar Path Gyro guided Leif Viking unerringly to its destination.*"

E. S. Pedersen (left) and Douglas Hembrough of Bendix examine the directional gyro spinning at 24,000 r.p.m., the "heart" of the Polar Path System.

BY LOTHAR LOSKE, ZURICH

From the Solar Column to the Universal Time Clock

The ancient Greeks already spoke of the heavenly bodies as the organs of time. The sun was used as a unit for the year, the moon for the month, and the fixed stars, with their apparent daily motion, provided the measure of time for the day. All this still holds good today.

Man's first time measuring device for the hours of the day was, as far as we know, the *shadow* thrown on the ground by a vertical shaft. It was observed that the shadow got shorter and shorter until it reached its minimum in the middle of the day, and then got longer again until sunset. Thus it was possible, for example, to determine the length of the shadow cast by one's own body at various times of the day, measuring it by the length of one's foot.

"When thy shadow measures sixteen feet, sweet Berenica, thy Amasis will be waiting for thee by the olive grove."—So may a fiery youth of ancient Egypt have arranged to meet the maiden of his choice. The next day Berenica invites her lover to supper at "four feet", and even if Amasis is a head taller than she, he measures his shadow with a longer foot . . . and appears on time.

Soon *sun rods* were set up in public squares, and the hours marked on the ground along the length of their shadows. Cleopatra's Needle, now in London, may have served for this purpose, like the Obelisk in the Place de la Concorde in Paris. As it was later discovered that the direction of the shadow was a better guide to time than its length, *sundials* came into use, whose shadow moves from West to East and thus marks the hours.

Sundials were often accurately made and richly decorated. Many portable sundials included a compass which—even as early as the 15th century—were marked for magnetic bearing. (If no allowance is made for magnetic variation, errors of up to half an hour can occur.) Even folding timepieces were made, which could often be used at night, with the aid of the stars.

Mechanical wheel clocks were introduced about 1000 A. D., though for centuries they had to be constantly checked by an astronomically reliable sundial.

The earth as normal clock

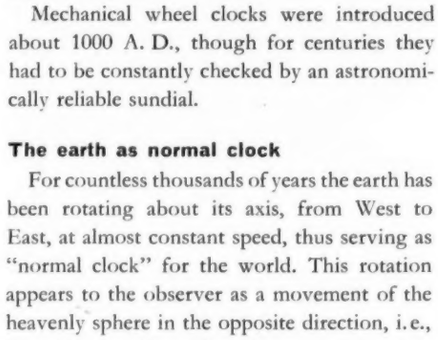
For countless thousands of years the earth has been rotating about its axis, from West to East, at almost constant speed, thus serving as "normal clock" for the world. This rotation appears to the observer as a movement of the heavenly sphere in the opposite direction, i. e., from East to West. There are only two points in the sphere which do not participate in this apparent motion: the two heavenly poles, the ends of the axis of the whole vault. The stars describe complete circles on the inner surface of this hollow sphere, either above or below the horizon, or cutting through the horizon, depending on the position of the observer.

The time taken by a given fixed star to describe a full circle—or expressed in technical terms, the time elapsing between two successive transits of a fixed star—is known as a *sidereal day*.

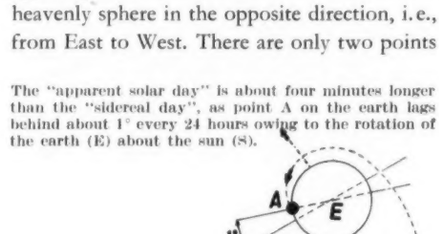
As, however, in ordinary civil life we measure time not by the stars but by the sun, the source of light, it is necessary to make allowance not only for the phenomena produced by the earth's rotation about its axis, but also for those resulting from the earth's motion round the sun. Here too we follow the indications of our senses and transfer the phenomena actually caused by the earth's motion to the sun . . . as if the earth were stationary and the sun moved. And just as the time interval between two successive transits of a fixed star through the meridian is called a sidereal day, so the time between one transit of the sun and the next is known as the *apparent solar day*.

However, the solar day is longer than the sidereal day (see diagram). If the earth had no trajectory motion and merely rotated about its own axis, the sun would also appear to remain stationary among the fixed stars and merely participate in the general movement of the whole firmament along with the other stars. As the earth moves eastwards by nearly *one degree* every day, the sun takes nearly four minutes longer than any other fixed star to reach the reference meridian.

The "apparent solar day" is about four minutes longer than the "sidereal day", as point A on the earth lags behind about 1° every 24 hours owing to the rotation of the earth (E) about the sun (S).



Folding pocket sun and star clock (with calendar) of gold-plated brass; made in 1514 by an unknown master.



As the earth moves round the sun on an *elliptical* orbit (obliquely to its axis), its speed varies at different points of the orbit (second Keplerian law). This motion of the earth, which appears to us as a movement of the sun among the stars, means that the sun moves with varying speeds and that apparent solar days are thus not all of equal length. No individual apparent solar day can therefore be used as a standard measurement of time, as could be the case with the sidereal day.

In their search for an unalterable fixed time measurement based on the apparent solar trajectory, astronomers finally found the *mean solar time*, i. e., days of constant length. They invented a second sun (or "mean sun"), which travels for a full year at constant speed along the celestial equator (not the ecliptic). Both suns, the "apparent" and the "mean," are considered to pass through the *vernal equinox o equal day and night* on the equator at the same time and to meet each other again a year later

at exactly the same time. The imaginary sun will thus advance among the stars by exactly 1/365.2422 of the length of the equator, or 0° 59′ 8″, per day.

As only the actual sun is observed, and time must be measured from its hour angle, all astronomical yearbooks (ephemerides) include a table giving the time difference between the transits of the apparent and the mean sun to within hundredths of a second. Mean time, also known as *local time*, was introduced in most European countries at the beginning of the 19th Century, first of all in England.

Everyday life today needs standard time

With the advance of transport during the past few decades it is no longer possible for two cities within a relatively short distance to have different "mean times". For example, the difference in "true midday" between Zurich and Geneva (sun exactly to the South) would be about 10 minutes. Under such conditions, it would be impossible to make even a railway timetable, let alone air transport schedules. This problem was solved by giving a larger area one and the same time and thus creating *zone standard times*.

The time differential for a given point is found from the number of degrees of longitude which separate it from the Greenwich meridian, since every degree of longitude corresponds to four minutes of time. Every 15 degrees of longitude therefore make a time difference of one hour. Hence the meridians 15°, 30°, 45°, 60°, 75°, 90°, 105°, 120°, 135°, 150°, 165° and 180° East and West of Greenwich have, with a few exceptions, been recognized as *zone time meridians* since about the beginning of the century.

For Central Europe (plus France, Belgium and Holland—Ed.—) longitude 15° E. is the zone meridian for Central European Time, and all places in the CET zone use the same time. *Eastern European Time* (EET = longitude 30° E.) is a full hour ahead of CET, and *Greenwich Mean Time* (GMT = 0°) is one hour behind. However, some places have chosen other longitudes than the multiples of 15 degrees mentioned, as zone time meridians, as for example, Quito (78° W.), Godthaab (51° W.), Etah, Greenland (73° W.). Burma, Hawaii, India, Iran, Malaya, Newfoundland, the Netherlands West Indies, New Guinea, Pakistan (West), Surinam and Venezuela also have special standard time meridians.

The continent of North America is, of course, so large that one zone standard time would not be sufficient. It has therefore been divided into five time zones, each differing from the next by one hour:

Atlantic Standard Time (A.S.T.)	60° W.
Eastern Standard Time (E.S.T.)	75° W.
Central Standard Time (C.S.T.)	90° W.
Mountain Standard Time (M.S.T.)	105° W.
Pacific Standard Time (P.S.T.)	120° W.

When it is noon in Greenwich (GMT: 12.00 hrs.), New Yorkers are at breakfast (EST: 7.00 hrs.) and the inhabitants of Los Angeles are still in bed (PST: 4.00 hrs.).

Summer time first introduced in Central Europe as "German Summer Time" and by Britain and America as "Daylight Saving Time" during World War I, means that clocks are simply put forward by one hour with the object of economizing daylight during the summer months. Germany abandoned the use of summer time again in 1949, but Argentina, Britain, Israel, Ireland and the eastern parts of the United States and Canada still use it.

Universal time and date line

The mean local time of the zero meridian, officially known as *Greenwich Mean Time (GMT)*, is today used as standard time in world transport.—Police, press and weather radio, as well as the whole of air and marine navigation, all use Greenwich Mean Time. The 24-hour day in this *universal time* begins when the sun crosses the international date line. Twelve hours later, when the sun is above the Greenwich meridian, is *universal noon*.

A journey eastwards takes the traveller towards the sun, and a journey westwards takes him away from it. A ship or aircraft travelling from the East coast of Asia to the West coast of America gains a day on crossing the date line (180th degree of longitude), so that a Sunday, for example, is followed by another Sunday. But a ship sailing from San Francisco to Yokohama loses a day at the date line, so that Sunday is followed by Tuesday.

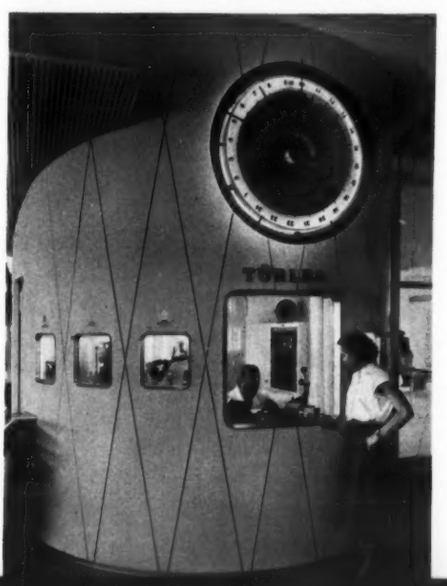
Equatorial sun clock to show apparent and mean solar time, standard time and date (designed by the author).

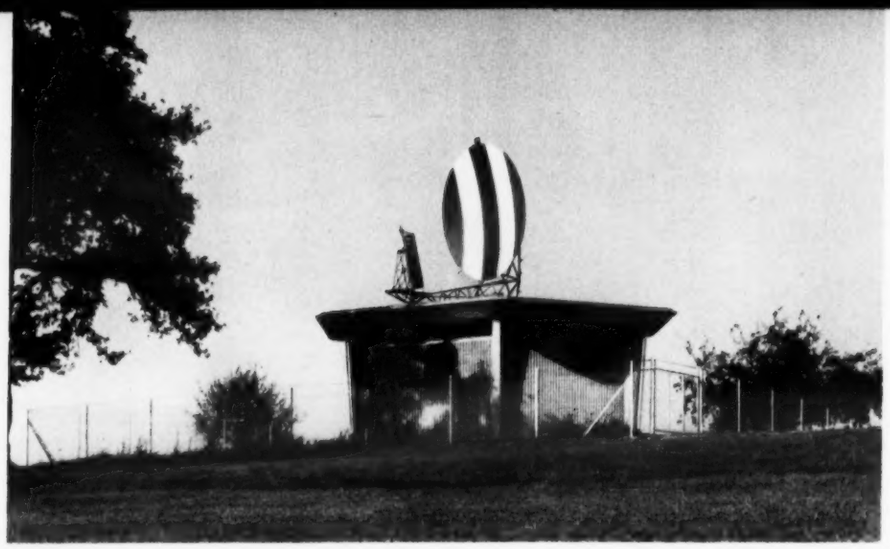
For practical reasons the *date line* does not correspond exactly with longitude 180°, but has been fixed so that it does not pass through any land area. To the North it passes through the Behring Straits, then to the West of the Aleutians, coincides with the 180° meridian to just South of the Equator, makes a detour to the East round the Tonga Islands and New Zealand and finally returns to the 180th meridian near the Antipodes Islands.

As already stated, international radio communications and intercontinental air transport use Greenwich Mean Time exclusively. Passengers, however, still need to know the local time at which they will land. A ten-hour flight is by no means the same thing as a ten-hour railway journey. Scandinavian Airlines System's Arctic services to California provide an interesting example. An S.A.S. passenger arriving in California after 27 hours of flight is actually only 18 hours older, as he has to put his watch back nine hours. In the opposite direction, however, he would age by 24 flying hours plus 9 hours difference in time.

Timetables of international airlines therefore always contain a table of comparative times from which the differences in standard time of the various points of call, compared with GMT, can be obtained. Universal time clocks, such as the one in the waiting room at Kloten Airport, Zurich (see picture), show not only the local standard time but also the standard times for another 25 places in the world.

Universal time clock (designed by the author and made by Türler & Co., Zurich), on the "watch-makers' tower" in Zurich-Kloten passenger waiting room. The earth is here regarded as a disc, with the North Pole at the centre; 25 place names are marked round the circumference on the appropriate standard time meridians, beginning with London and Shannon at the top (zero meridian or universal time). As the real earth rotates about its axis from West to East once every day, but the central disc of the clock remains stationary, the hour figures (1 to 24) on the white ring move in the anti-clockwise direction. They thus always indicate the correct standard time for each individual place. Each zonal segment corresponds to a time difference of one hour; minute and second indications remain the same throughout the world.





Aerial and equipment building for the Cossor surveillance radar on the Holberg, a hill to the East of Zurich-Kloten Airport. The hexagonal ferro-concrete structure carries the rotating aerial array and houses mains and high frequency equipment for the transmitter-receiver.

Radar Installations at Zurich-Kloten Intercontinental Airport

The radar installations which had been built up stage by stage at Zurich's intercontinental airport over the previous three years were demonstrated to the public for the first time on November 17th, 1954. The equipment comprises a *surveillance radar element* (SRE), which detects and reports all aircraft within a range of up to 60 nautical miles and up to altitudes of approx. 20,000 ft., and a *precision approach radar* (PAR), which controls landings at Zurich in bad weather. The surveillance radar, made by Cossor Radar Limited, London, uses 10-cm waves, while the approach radar, supplied by Standard Telephones and Cables, London, works on 3-cm waves.

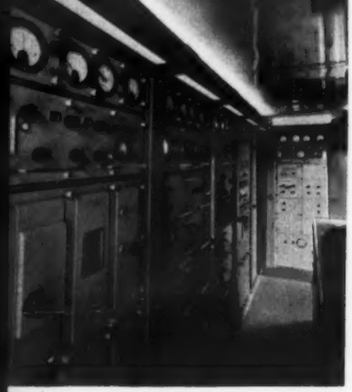
At the demonstration of these modern installations, which was equally convincing in flight and at the screens, *Dr. P. Meierhans* and *Dr. E. Altdorfer* (Directorate of Public Works, Canton of Zurich) and *Dipl. Ing. A. Fischer* (Radio Switzerland) stated that with this radar equipment it was now possible to exercise completely reliable control of aircraft on the airways and during approach and to bring aircraft down to a safe landing even in the worst visibility and with the lowest cloud base. The only proviso is that pilots must be able to see the high-intensity runway lights from a height of 13 ft. (!). Zurich thus has one of Europe's most modern air traffic control systems.

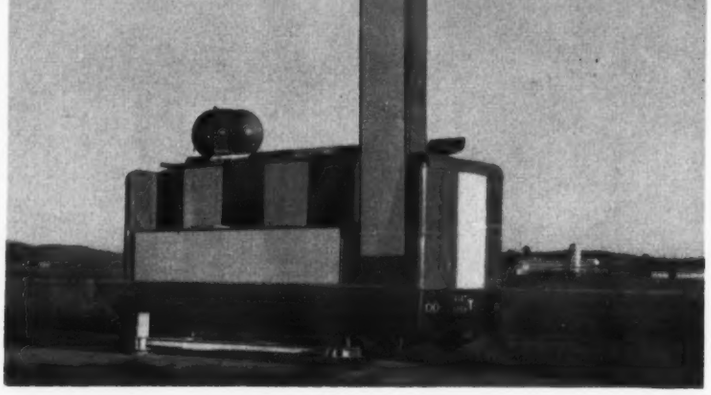
The pictures on these pages give a good impression of the appearance and operation of the two radar installations. Technical data are as follows:

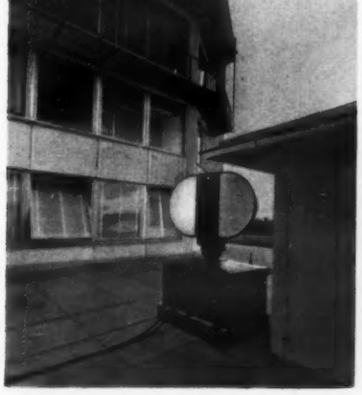
SRE radar: Type Cossor Mark 6; frequency 2,960—2,980 mc/s; peak output power 450 kW; pulse duration 1 microsecond; repetition frequency 850 c/s; measuring range (selected at the control desk) 10, 20, 40 or 60 nautical miles; accuracy ± 1° in azimuth, ± 1% (or ± 0.25 nm) in distance; discrimination 2° for aircraft at the same range and 0.25 nm for aircraft in the same direction; aerial reflector of metal-coated plastic, diameter 14 ft.; scanner rotation 10 or 15 r.p.m.; the aerial building (on the Holberg hill) is linked to the control tower by co-axial cable.—There are two parallel display units, each with a single daylight screen 12 inches in diameter, in the control tower, where they are used for both approach control (side by side with the PAR) and airways control. A Moving Target Indicator (MTI) is used to eliminate permanent echoes from fixed objects; without it the equipment

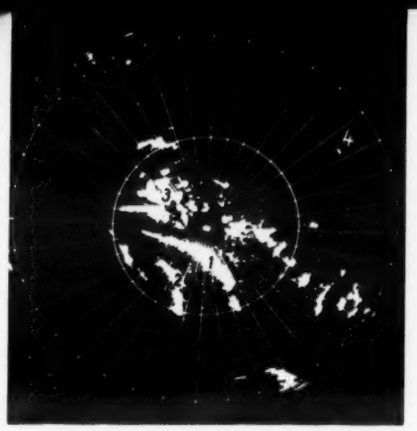
The aerial array of the surveillance radar consists of twelve radiation elements (left), a wave conductor (discernible in the centre of the supporting arm) and the 14-ft. parabolic reflector of metal-coated plastic. The whole turns at 10 (or 15) r.p.m.

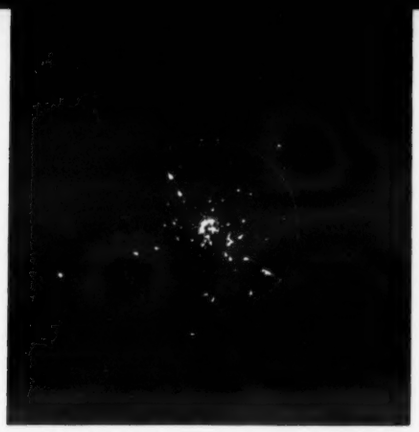
The aerial trailer of the Standard precision approach radar is stationed on a turn-table near the intersection of the instrument landing runway and the West runway and can thus be used for both landing directions. The vertical aerial scans the approach section up and down, the horizontal aerial from left to right. Transmitter and receiver for the approach radar, together with all accessory equipment, are housed inside the trailer (left), the radar screens are set up in the control tower approx. 1,000 yards distant. Signals are transmitted by radio link, the parabolic aerials for which can be seen on the vehicle roof in the centre picture and beside the control tower in the right hand picture.









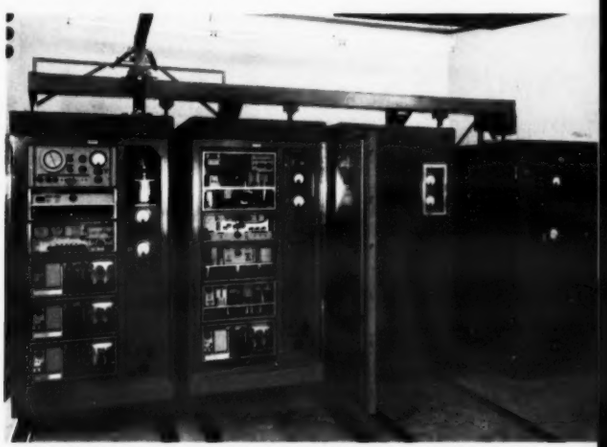


Two views of the screen of the Cossor surveillance radar: *left*, before elimination of permanent echoes from fixed obstructions; *right*, after elimination of permanent echoes. The equipment is set at 20 nautical miles range, so that the four circles correspond to distances of 5, 10, 15 and 20 nautical miles. The radial lines mark intervals of 10°. In the left-hand picture Zurichberg (1), Uetliberg (2) and the Lägern hills (3) are clearly discernible, but only one aircraft (4) 16 nautical miles distant. By comparison, the right-hand picture shows the situation in the air after suppression of echoes from fixed objects. All aircraft within range – as well as a number of flights of birds – are now clearly visible.

The screens of the Standard precision approach radar: *left*, the elevation screen, with oblique line showing correct glide path; *right*, the azimuth screen, on which two vertical light lines indicate the correct approach path. The cross lines on both screens provide a reference for distance measuring. Echoes from fixed objects do not hamper the observer here. An aircraft (A) approaching slightly too far to the right and slightly too low is seen about 5 nautical miles distant.

would be useless in the Alpine and pre-Alpine regions.

PAR radar: made by Standard Telephones and Cables Ltd.; frequency 9,080 mc/s; peak power 30—50 kW; pulse duration 0.25 microseconds; repetition frequency 3,420 c/s; measuring range 10 nautical miles; distance accuracy ± 110 ft. up to 2 nm, ± 1% over 2 nm; azimuth accuracy at touch-down point ± 16 ft.; elevation accuracy at touch-down point ± 11 ft.; discrimination 220 ft. (distance) and 0.6° (azimuth and elevation).—The two daylight screens 12 inches in diameter for elevation (left) and azimuth (right) are installed in a common desk in the control tower and have no Moving Target Indicator to eliminate fixed echoes. The aerial trailer, with wheels removed, rests on a turn-table, so that it can be turned towards the instrument runway or the West runway as required. It has two similar aerials 15 ft. 6 ins. long, the vertical one (for elevation) being foldable for ease of transport. Signals are transmitted from the aerial trailer to the control tower and vice versa by means of a radio link consisting of two small parabolic reflectors and transmitter-receivers, one at each end of the link.

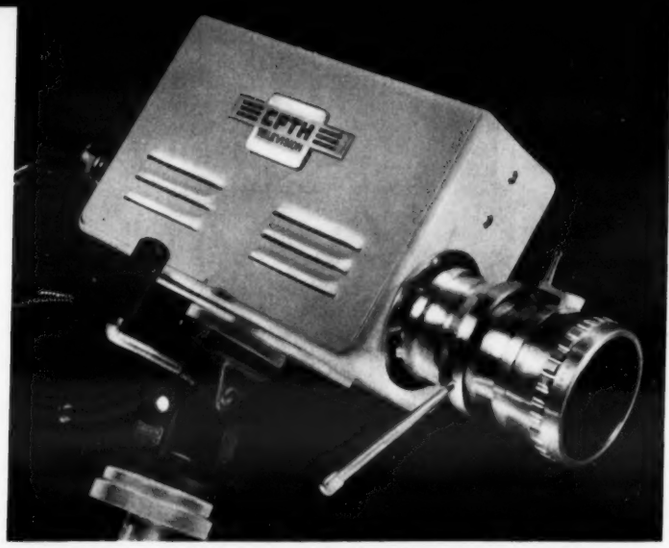


The so-called "radar head" of the Cossor surveillance radar (right-hand picture) shows, right to left: mains stabilizer and temperature control equipment; remote control unit; modulator with magnetron; receiver and checking equipment. – Important parts of this installation can be checked even during operation (left-hand picture).

The two installations are complementary. The *PAR* brings aircraft in to a safe landing in bad weather, and the *SRE* directs them to the best or shortest path to the beginning of the landing approach. as a rule to the "Rhein" beacon North of the instrument runway. Aircraft need be equipped only with the normal VHF R/T equipment (and blind flying instruments). The surveillance radar also enables the safety distances between aircraft to be reduced, as the air traffic controller no longer has to rely solely on the crews' own position reports, but can get his picture of the situation direct from the radar screen.

The radar approach control room, shut off by curtains, at Zurich-Kloten Airport contains *left* the approach controller's desk (Standard; two screens) and *right* the surveillance controller's desk (Cossor; one screen). Between the desks, within reach of both controllers, is the frequency selector for R/T communications with aircraft.

A second screen for the Cossor surveillance radar is set up in the neighbouring airways control room at Zurich-Kloten. To the right of this desk – not in operation in the picture – two airways controllers work at the progress boards of their control area.



Thomson-Houston television camera: designed for the transmission of radar images, the camera has been equipped with a special orthicon tube.

Radar and Television at Orly Airport, Paris

BY E. GUIGONIS, MANAGER
OF THE GROUPE ELECTRONIQUE, COMPAGNIE FRANÇAISE
THOMSON-HOUSTON, PARIS

Paris-Orly Airport building (left) and aerial mast with rotating aerial (right) of the long-range surveillance radar for the Regional Control Centre North (makers, Thomson-Houston).

Last December 16th, Monsieur E. de Lassus, President and Managing Director of Compagnie Française Thomson-Houston, officially handed over to the Minister of Public Works, Transport and Travel the regional control radar system constructed by his company. The long-range radar system, installed at Orly, had in fact already been in service for a year[1]. The presence at the ceremony of Monsieur Longchambon, Secretary of State for Scientific Research and Technical Progress, underlined the importance of the event as marking the introduction of full-time air traffic control beyond the airport borders.

To make the demonstration more impressive, Compagnie Française Thomson-Houston televised the image of one of the radar screens on to a special screen measuring 21.3 ft. by 16.7 ft., so that nearly one thousand persons could follow the progress of aircraft in the Regional Control Area. A system of video mapping showed the navigation landmarks on the immense luminous map.

This striking demonstration showed that television could be used in the near future as a valuable aid in the evaluation of radar information. Television cameras specially designed to analyse radar images could be used to solve a number of problems to which there has hitherto been no solution. For example, current television technique can be employed to superimpose the necessary information (in the form of conventional symbols, groups of letters or figures) on the radar image, so as to make the latter immediately utilizable by the Air Traffic Control.

The same method could also be used, it seems, to superimpose on the radar image the readings from a network of D/F stations with cathode ray screens spread over the area to be covered. Finally, the televised image can readily be transmitted by radio link and thus evaluated, if required, long distances away.

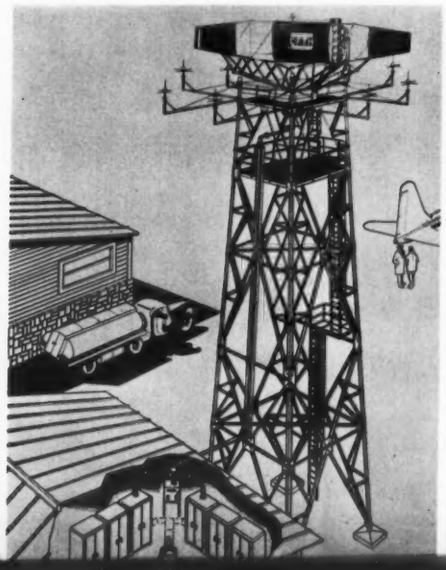
It is interesting to note that the televised image can be shown as either a positive (white on black) or negative (black on white). The latter form of presentation seems to be much more pleasant and less tiring to the eyes. Compagnie Française Thomson-Houston is playing a leading part in this new domain. It has already installed a television system for the radar at the port of Le Havre, enabling vessels equipped with a simple receiver to follow their own progress in the entrance channel.

*

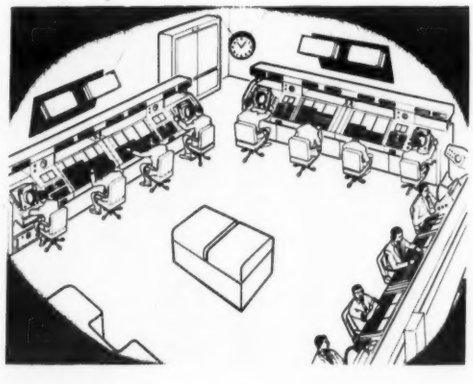
The new regional control radar completes the range of Thomson Houston radar equipment designed for Paris Airport, which also includes an airport surveillance radar and a precision approach radar.

[1] cf. "The Paris Area Control Centre and its Equipment", by Jacques Villiers, Air Navigation Engineer, in *Interavia* No. 5, 1954, pp. 307 – 309.

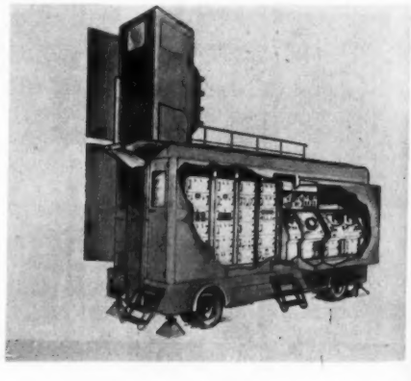
Drawing of the aerial mast (with aerial array and parabolic reflector) and the cabinet for the transmitter-receivers of Orly's surveillance radar.



Drawing of the main control room of the Regional Control Centre North, Paris-Orly; six control desks, each with a radar screen, cover the various sectors of the region.



Aerial trailer for the Thomson-Houston precision approach radar, such as has been supplied to a number of N.A.T.O. bases. Fixed installations have been built at Brussels, Amsterdam, Copenhagen, Geneva, Milan and Paris Airports.



What's in the Air?*

AVIATION POLITICS

• European Arms Pool ?

A French proposal for the creation of an arms pool of the seven parties to the Paris Agreements (Belgium, France, Germany, Great Britain, Italy, Luxembourg, the Netherlands) has come up against difficulties in several countries (Britain, Netherlands, Germany). The French plan calls for three organizations: a planning office for European arms, an equipment standardization committee and a production committee for the allocation of arms orders from European countries and American off-shore orders.

• Franco-Italian defence talks

Both Prime Minister Pierre Mendès-France and Chief of the French Air Staff General Pierre Fay have been visiting Rome. The latter had talks with his Italian colleague, General Ferdinando Raffaelli, and with the Italian Government on collaboration between the two countries' air forces and aircraft industries.

• "Firing ranges" 5,000 miles long . . .

According to a report from Washington, the U.S. Government has opened negotiations with the British Government to extend the Florida guided missile range to the British territories of St. Lucia in the Windward Islands and Ascension Island in the South Atlantic. The extension, which the State Department claims would play a "valuable part in Western defence," is noteworthy, since the distances between Florida and St. Lucia and between Florida and Ascension are 2,000 and 5,000 miles respectively.

SERVICE AVIATION

• U.S. Air Force in the lead

President Eisenhower's "State of the Union Message" to the Congress announces a reduction in manpower in the U.S. armed forces from 3,040,000 to 2,928,000 in the next 18 months. However, only the Army (from 1,343,000 to 1,000,000), the Navy (from 692,000 to 650,000) and the Marine Corps (from 220,000 to 190,000) will be affected by these economy measures, while the personnel strength of the U.S. Air Force will be increased from 961,000 to 975,000.—The increased strength of the air forces will benefit not only Strategic Air Command, but also Continental Air Defense Command (General Chidlaw), which is to receive much bigger resources (fighters, rockets, radar installations).

• Reinforcement of the Spanish Air Force

According to *Interavia's* Madrid correspondent, a spokesman of the U.S. military mission in the Spanish capital has stated that Spain will be able to form three new fighter and fighter-bomber squadrons by 1957, with the aid of American aircraft deliveries. The first modern aircraft for these units will arrive in the spring of 1955. They are similar types to those used in the Korean war.

AIR TRANSPORTATION

• Record results in American civil aviation . . .

Private and commercial aviation in the United States "broke all previous records for traffic and safety" in 1954, according to the year-end report issued by Civil Aeronautics Administrator F. B. Lee.

Scheduled airlines carried 34,763,000 revenue passengers (10% more than in 1953). Safety record, based on the number of lives lost per 100,000,000 passenger-miles travelled, was better than that of the railways in 1953.

Robert E. Gross, Board Chairman and President of Lockheed Aircraft Corp., Burbank, California, has been elected President of the Institute of the Aeronautical Sciences, New York, in succession to J. L. Atwood, President of North American Aviation Inc.

Italian Air Force Captain *Riccardo Bignamini*, Fiat test pilot, took first place in the contest at the Empire Test Pilots School, Farnborough. In recognition he was awarded the McKenna Trophy.

Charter airlines had had only one fatal accident in 16 months of operation (a Douglas DC-3 of Johnson Flying Service Inc. crashed at Pittsburgh on December 23rd, 1954).

Don Cesar Gomez Lucia, Managing Director of Iberia, at the opening of Iberia's Madrid – New York service (August 1954). Rumour has it that Iberia is planning to expand its fleet.

Flying in business aircraft was estimated at 3,900,000 hours, 700,000 hours more than the total for domestic and international scheduled airlines.

Civil aircraft production jumped 20% in dollar value, though the number of aircraft produced dropped from 4,134 in 1953 to 3,300 in 1954. Deliveries during 1954 brought the U.S. aircraft industry a total revenue of approx. $408,000,000.

• . . . and record turnover for P.A.A.

Pan American World Airways announces that 1954 brought the highest operating figures in the airline's history. Turnover increased by $8,000,000 to $226,000,000. Revenue from passengers was 9% higher than the previous year, freight revenue 14% and Atlantic freight revenue 25%.—According to P.A.A. President Juan T. Trippe, the firm plans to be operating *daily all-cargo flights* across the Atlantic "before the end of 1955".—Referring to the differences of opinion among I.A.T.A. companies on the question of Atlantic freight rates, Trippe said he hoped that agreement would be reached before the spring season.

Engineer Giuseppe Lojacono, President of Finmeccanica (Società Finanziaria Meccanica), who has held leading positions in the Italian industry for the past 40 years, has been awarded a medal by the Istituto per la Ricostruzione Industriale. Left: President Lojacono; right: President of I.R.I., *Engineer Isidoro Bonini*.

• Airmail between France and the Soviet Union

Since December 1st, 1954, postcards and letters weighing not more than 20 grammes have been carried by Air France and Aeroflot between France and the Soviet Union without surcharge, at the normal postage rates.

• Air France 1954 results

A provisional Air France gives the following traffic figures for 1954: 2,060,000,000 passenger-km

* Extract from *Interavia Air Letter*, daily international news digest in English, French and German. All rights reserved.

(1953: 1,716,000,000; + 18%), 226,500,000 tonnes-km (1953: 225,000,000).

● Sabena's helicopter fleet

The Belgian airline Sabena has purchase two more helicopters of the Sikorsky S-55 type, which are to be delivered at the end of February 1955. This increases the company's helicopter fleet to six S-55s.

INDUSTRY

● U.S. aircraft industry in 1954

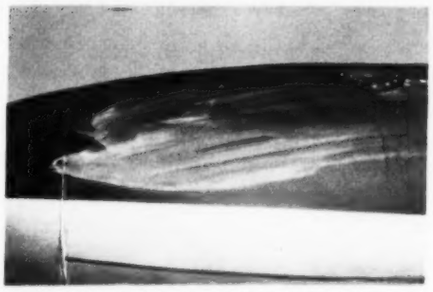
Despite a slight fall in the production of military aircraft, the Aircraft Industries Association of America announces a remarkably high level of total production. A.I.A. President Admiral DeWitt C. Ramsey estimates 1954 deliveries at a total of $8,600,000,000 (1953: $8,500,000,000). With a labour force of 797,400 workers (on September 30th, 1954), the American aircraft industry ranks above all other industries (followed by 583,900 in the steel industry and 495,500 in the electronics industry).

● U.S. production of guided missiles increases 106%

The United States output of guided missiles increased by 106% in 1954, compared with the previous year. According to a statement by H. A. Bell, President and founder of the electronics firm of Packard-Bell Co., Los Angeles, a considerable proportion of the West Coast aircraft industry's order backlog ($6,000,000,000) is made up of guided missiles. On October 1st, 1954 unused appropriations of all three armed services for electronic equipment and guided missiles stood at $4,387,000,000.

● Bank institute as purchaser of the Boeing 707 ?

It is believed in Californian aviation circles that a newly-created finance institute is to purchase Boeing 707 jet transports and then charter them to airlines. Although Boeing could give *Interavia's* Los Angeles correspondent no confirmation of this report, it would not appear to be altogether unlikely, in view of the high purchase price of this aircraft ($4,000,000 to $4,500,000).



During a test flight by a T-33 *Silver Star* jet trainer over Montreal-Cartierville airfield a flight of pigeons flew into the aircraft; the result.

AIRCRAFT AND EQUIPMENT

● The *Douglas B-66* twin-jet bomber, latest version of the A3D Navy bomber, began flight testing at Douglas's Long Beach Division airfield at the beginning of January. According to Douglas reports, a "considerable number" of the B-66 version has been ordered.—It will be recalled that the RB-66 version of this type began flight testing in June 1954.

● Stability and control problems in modern combat aircraft in the Mach 1+ speed range will apparently need considerable research work before there can be any talk of a reliable solution. A number of American spokemen have stated that practically all the U.S. Air Force and Navy's supersonic aircraft show serious loss in stability and controllability as soon as they are subjected to even small accelerations (of only 2 g) at speeds of Mach 1+.

● A transport version of the *Grumman S2F-1* twin-engined anti-submarine aircraft (eight passengers or approx. 1,600 lbs. of freight) is about to begin flight testing.

● C.A.A. certification tests with a first Lockheed *Lodestar* converted by *Lear Incorporated,* Aircraft Engineering Division, Santa Monica, California, are nearing completion. The converted *Lodestars* are to be marketed as *Lear Learstars,* for use as 10 to 12-seat executive and touring aircraft. Lear plans to convert two *Lodestars* into *Learstars* a month during the year.

● The electronics division of *Curtiss-Wright Corp.* is producing *flight simulators* for the following aircraft types, under contract to the U.S. Air Force: Boeing B-52, Convair C-131, Douglas C-118A and C-124A and Lockheed C-121D and C-130. It was also recently announced that Curtiss-Wright has received an order from P.A.A. for a DC-7C simulator.

● De Havilland Canada is developing an amphibian version of the DHC *Beaver* single-engined multi-purpose high-wing monoplane. An experimental version of the amphibian is already making flight tests.

● Three of the five pre-production models of the *SIPA S.200 Minijet* light French jet trainer have been completed and taken to Villacoublay. Two more *Minijets* are in final assembly at SIPA's Suresnes plant.—SIPA also announces that flight testing of the S. 300 jet trainer is continuing at Villacoublay.

● From the beginning of flight testing of the *Fouga CM.170-R Magister* twin-jet trainer (the first prototype made its maiden flight on July 23rd, 1952) up to the end of 1954, seven of these aircraft were completed and tested. The production programme calls for delivery of a total of 25 aircraft by the end of 1955 and 96 by the end of 1956.

● Atomic power plants for industrial and aviation use are under development in the Soviet Union, according to the "Red Star".

● All Royal Swedish Air Force *Venom* single-seater fighters are to be fitted with Messier wheels, brakes, hydraulic systems for brakes, as well as the Messier "Ministop" brake control.

● Flight testing of the *Nardi FN 333-S* amphibian has begun at Milan-Linate airport.

● First reports have been received from France of the existence of a new guided missile, the *SFECMAS S.S. 10.* The missile, which can be used either from ground to ground or from air to ground, can also be launched by relatively untrained personnel. The S.S. 10 can be fired from helicopters against ground targets.

● The French firm of *SNCA du Nord* is at present producing the following types: *Nord 2501 Noratlas* twin-engined transport (SNECMA-Bristol *Hercules* engines; for the Air Force); of the 140 aircraft ordered, a total of 53 had been delivered by December 15th, 1954.—*Nord NC.856 Norvigie;* 52 out of a total of 110 ordered had also been delivered by December 15th. The NC.856 (two-to-three-seater) is designed primarily for artillery observation.

Martin XP6M-1 Sea Master with four Allison J-71 turbojets of approx. 10,000 lbs. thrust each (without afterburners). The *Sea Master* is to be used as anti-submarine aircraft, as well as for mining, bombing and reconnaissance missions.

Swiss Federal Councillors — Correction

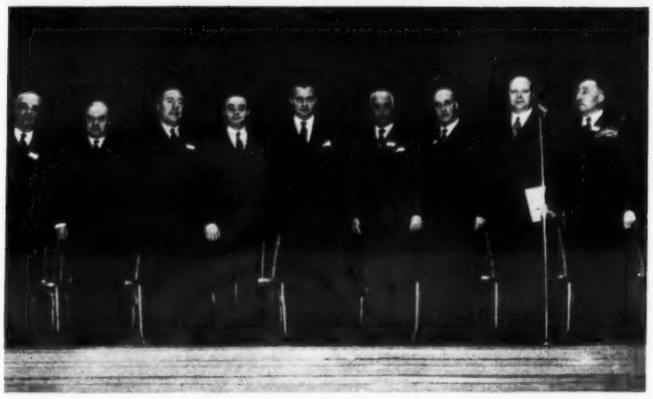
The January 1955 issue of *Interavia* contained pictures ("What's in the Air ?" p. 56) of Federal Councillors Dr. T. Holenstein and G. Lepori. The information given in the caption, based on agency messages of the time, has since been found to be incorrect. Actual new appointments to the Swiss Government are as follows: Federal Councillor *Paul Chaudet* has taken over the Military Department, the new chief of the Federal Posts and Railways Department, which also covers civil aviation, is *Giuseppe Lepori,* while Dr. Thomas Holenstein took over the Economic Department.

First European Aeronautical Congress

Paris, December 14th—18th, 1954

Organized by the French Association of Aeronautical Engineers (A.F.I.T.A)

under the patronage of the International Association of Aircraft Manufacturers (A.I.C.M.A.)



Left to right : Charles Dechevrens (President of the Swiss A.S.I.A.) ; General Fay (Chief of the French Air Staff) ; Maurice Heurteux (President of Hispano-Suiza) ; Jules Jarry (President of A.F.I.T.A.) ; Diomède Catroux (French Air Minister) ; General Alfredo Bruno (President of A.I.C.M.A.) ; Prof. E. Pistolesi (President of A.I.D.A.) ; Georges Héreil (President of S.N.C.A.S.E.) ; General M. Valin (Inspector-General of the French Air Force).

The success of this first attempt at a continental European aeronautical engineering congress may well have surprised even its organizers. Scientists, designers and industrialists from eleven countries (Austria, Belgium, France, Germany, Greece, Holland, Italy, Spain, Sweden, Switzerland, Yugoslavia) sat together in Paris for five days, listening to and discussing more than 50 papers. Aerodynamics, airframe production, power plant, accessories ... the lectures built up a comprehensive picture of the present position and future plans of European aeronautical engineering. And the lectures were by no means all. Lively discussion and personal contacts were found to be so stimulating that the participants decided to make the *European Aeronautical Congress* into a permanent institution and to meet *every two years*.

This success was due to a number of causes. Firstly the *organizers*, the French Association of Aeronautical Engineers and Technicians *(Association Française des Ingénieurs et Techniciens de l'Aéronautique)*, and its President *J. Jarry* not only possess the necessary qualifications (as the excellent bi-monthly journal " Technique et Science Aéronautiques " published by the Association proves), but have for years been energetically advocating European cooperation. This programme also covers the Association's cooperation with the International Association of Aircraft Manufacturers *(Association Internationale des Constructeurs de Matériel Aérien)* under whose patronage the Paris congress was held (in connection with an A.I.C.M.A. meeting which was taking place at the same time).

Secondly, success was due to the high standard of the papers read. In the limited space available here it is not possible to do more than list the general domains covered (sections of the Congress) :

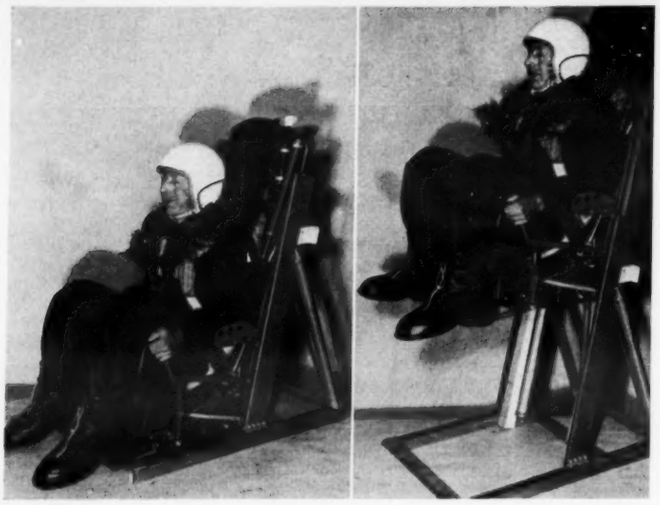
Aerodynamics —	Chairman : Professor Enrico Pistolesi (President of A.I.D.A.).
Structural Metals —	Chairman : M. Soriano (Secretary-General of A.T.E.C.M.A.).
Aircraft power plant —	Chairman : Professor Quick (D.V.L.).
Accessories —	Chairman : M. Haus (Pres. of the Scientific Committee of the Belgian C.N.R.A.).
Airframe production —	Chairman : M. van Meerten (Technical Director of Fokker).
Aviation medicine —	Chairman : Colonel Grandpierre (French Air Force's Biological Research Centre).
Non-metallic materials —	Chairman : M. Moutte (Air Engineer General).
Metric standards —	Chairman : M. Viaud (Inspector-General of the French Standards Office).
Vertical take-off aircraft —	Chairman : M. Garry (Air Chief Engineer).

Visitors to the conference, which was held at the Hotel des Ingénieurs in Paris, were officially welcomed by Air Minister Diomède Catroux on behalf of the French Government. A.I.C.M.A. President General Alfredo Bruno added to his address of welcome a report on " A.I.C.M.A.'s Technical Objectives and Industrial Resources," and Monsieur Vinsonneau, chairman of A.I.C.M.A.'s Committee for the Standardization of Research and Production Methods read a report on the work of his Committee.

Left to right : G. Héreil (President of S.N.C.A.S.E.) ; M. Guilbot (Pres. of the French U.S.I.A.) ; M. Heurteux (Pres. of Hispano-Suiza) ; P. Bréguet.

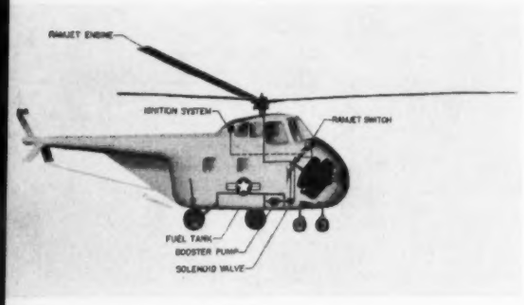
Left to right : B. Duperier (Technical Adviser to Air Minister Catroux) ; General Valin (Inspector-General of the French Air Force) D. Catroux (French Air Minister).

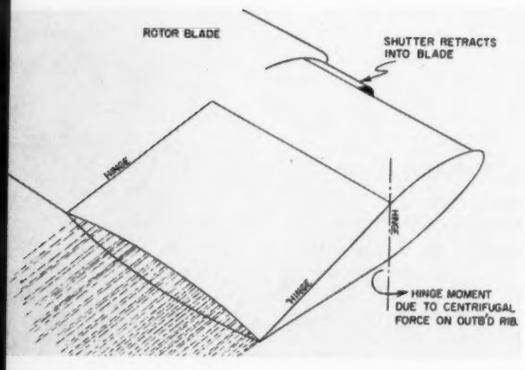
Right to left : L. Christiaens (former Air Minister) ; J. Jarry (Pres. of A.F.I.T.A.) ; D. Catroux (French Air Minister) ; General A. Bruno (Pres. of A.I.C.M.A.) ; H. Ziegler (Section Head at the Transport Ministry) ; G. Héreil (Pres. of S.N.C.A.S.E.) ; M. Tastevin (Section Head at the Air Ministry) ; G. Glasser (Pres. of S.N.C.A.S.O.).



Equipment Round-Up

• **A fully automatic ejection seat** with telescoping guide tracks has been developed by Lockheed and is being installed in the F-94C *Starfire* all-weather jet fighter. The telescoping rails provide better clearance for the seat upon ejection than conventional ejector seats.





• Integral ramjet engines for rotor blades

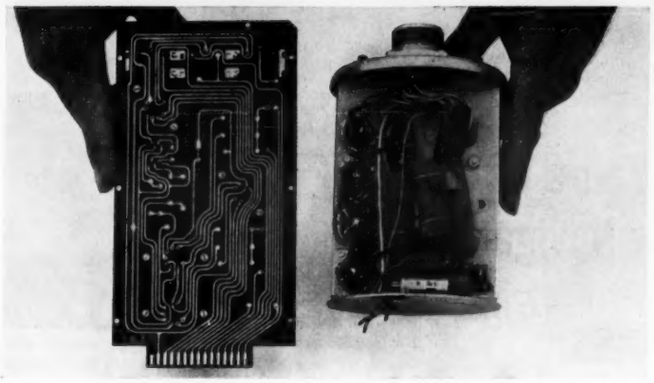
To increase the take-off and hovering performance of helicopters, Marquardt Aircraft Co., of Van Nuys, California, has developed " two-dimensional " ramjet engines which are fitted inside the rotor tips and are integrated both aerodynamically and structurally with the blades.—The engines shown here are experimental versions, which still have to be thoroughly tested in flight.

The rotor blade leading edge is split to form an air intake in the region of the ramjet and can be covered by a folding louver. Top and bottom of the actual combustion chamber are formed by two elastic plates held in hinges. Under the pressure of the exhaust gases these plates, which overlap at the rear, open to form a slit. When the engine is not running (and the intake is closed) the plates close automatically, and the blade tips take on the same aerodynamic profile as the rest of the blades.—The present experimental model weighs only 4 to 5 lbs. per rotor blade and delivers an additional thrust of 40 lbs. with a tip speed of 650 ft./min. Additional drag with engine stopped is about 3 lbs.

As the power required for take-off and hovering in helicopters is almost twice as great as for cruising flight, such " power-boosting aids " can increase the helicopter's payload and improve its economy, which is otherwise low in comparison with that of fixed-wing aircraft of the same weight and power class.

• Radiosonde with thermistors

N. V. Philips Gloeilampenfabrieken, of Eindhoven, have developed, in conjunction with the Royal Netherlands Meteorological Institute, a new-type radiosonde for weather balloons, in which temperature and pressure are measured by means of thermistors (electronic thermometers). By using especially light construction, weight has been kept down to about half that of radiosondes hitherto in use. Mean speed of ascent to the balloon's ceiling (15 to 25 km depending on atmospheric pressure) is 18 km/h. Measurement values for temperature, pressure and humidity are transmitted to the ground station in the form of audio frequencies, as in ordinary radiosondes. —Temperature is measured on the principle of thermo elements, with the resulting currents, suitably amplified, being used to modulate a carrier frequency. Pressure is measured as follows: about 3 cm^3 of freon fluid, whose boiling point is *below* normal air temperatures, is carried in a glass tube open at one end. A fall in atmospheric pressure causes a change in boiling point, so that by measuring the boiling point corresponding to the barometric altitude it is possible to get the equivalent pressure. Humidity is determined with the aid of a stretched animal membrane. The variations in length caused by changes in humidity create voltage changes in an electrical coil, and these too are sent to the ground in the form of an audio frequency. The thermistors used react very rapidly to variations in temperature and give a reading accurate to within 0.5°C. Pressure accuracy is ± 5 millibars.

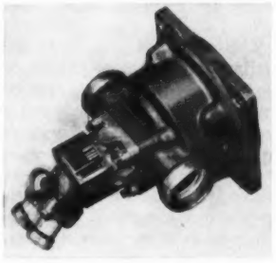


• Course stabilizer for sports and touring aircraft

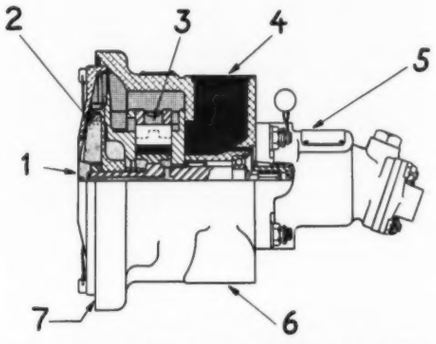
All aircraft tend to fly in a circle, a tendency which is not always realised in time by inexperienced pilots, especially during instrument flying. Lear Inc. has therefore designed the *Arcon* course stabilizer, which weighs only 12 lbs. and can be fitted in all small and medium sports and touring aircraft. The instrument serves merely to keep the aircraft on a straight course and has no effect on attitude or rolling. The amount of corrective force applied to the rudder is just sufficient to cancel out the tendency to turn.

The *Arcon* consists of three separate units, the rate gyro, the servo unit and the amplifier. The gyro is normally installed on the main spar, while the amplifier can be fitted anywhere where there is convenient space. The servo unit is best installed near the tail, where it can be most conveniently coupled to the rudder controls. The A.C. motor of the gyro is driven by a small generator, which is directly coupled to the armature shaft of the D.C. motor in the servo unit. The rate gyro runs at approx. 20,000 r.p.m., and its axis of rotation is parallel to the longitudinal axis of the aircraft. The magnitude and direction of the gyro tilt are sensed by a pair of opposing coils with variable air gaps in the flux path of each coil. As the gyro tilts, one coil becomes more highly energized than the other. The difference in voltage is then connected to the input of the amplifier and signals the direction and amount of change required to stop the aircraft from turning. The signal is amplified to actuate the servo gear box, which in turn acts on the rudder cable. To cut down production costs and to avoid the danger of cable breakages, the amplifier is made with an etched electrical circuit. Magnetic amplifiers are used instead of tubes ; these are less sensitive and light in weight, eliminate heat and have a longer service life.—The *Arcon* has been certificated by the C.A.A. and is now in production at the LearCal Division at Santa Monica, California.

• Hydraulic fluid boost pump



Vickers Inc., of Detroit, Michigan, has developed a two-stage booster pump for hydraulic fluids, which is particularly suited to installation in tanks separated from the main hydraulic system. With the aid of this pump, fluid from the tank is fed under pressure to the main system pump, without it being necessary to pressurize the tank.—Power is supplied by a Vickers MF-3906 motor driven by fluid bled off the main hydraulic system at a pressure of 3,000 p.s.i. The reservoir oil passes into the first (centrifugal) stage of the pump under the influence of gravity, then passes to the vane pump section which generates hydraulic system supply pressures up to 100 p.s.i. The model AA 15500 pump can generate hydraulic power varying between 5 gals./min. at a differential pressure of 100 p.s.i. and 35 gals./min. at 18 p.s.i. Weight of the pump with motor is 9.1 lbs. Depending on the motor size used, delivery from the booster pump is 23 to 33 times greater than the fluid flow through the driving hydraulic motor.

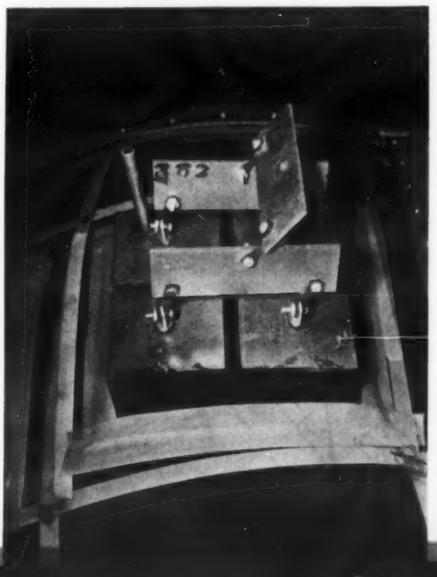


1- intake ; 2- first stage of pump (centrifugal) ; 3- second pump stage (vane section) ; 4- exit ; 5- hydraulically driven motor ; 6- exit ; 7- support flange.

• Tension pads for proof loading aircraft surfaces

A new method of simulating the loads exerted by air forces on aircraft surfaces has been developed and patented by North American Aviation Inc. Formerly pads had to be glued or cemented to the surface for proof loading, but now vacuum-held tension pads are used instead. They have the advantage of rapid application and removal and can be used repeatedly without limit, whereas the old type of pad had to be left to cure for 24 hours after application and needed 30 minutes of careful work to remove, after which they had no further use. With the aid of the new pads, loads of up to 14 p.s.i. can be applied to the surface, so that virtually all likely air forces can be simulated, including those on control surfaces.

The vacuum pads are built up as follows : a non-porous layer separated from the test surface by a porous membrane (burlap, plastic wire screen, etc.). The edges of the non-porous layer extend over the porous membrane and serve as a sealing edge, and an additional guarantee of a vacuum seal is obtained by using tape or caulking compound. Air is then withdrawn from between the non-porous layer and the test surface through a hole in the former. On the other side of the non-porous layer is a sponge rubber pad, to which one or more load distribution plates are attached. The latter vary in size, depending on the curvature of the specimen concerned. Hence the pads can be applied to practically any contour, without leaving behind any bending or buckling, since atmospheric pressure acts equally on the specimen surface and the non-porous surface. The full efficiency of the new method was proved in the pre-flight tests of the North American F-100 *Super Sabre* supersonic fighter, whose control surfaces, doors, canopy, etc., were proof loaded in this way in a minimum of time.



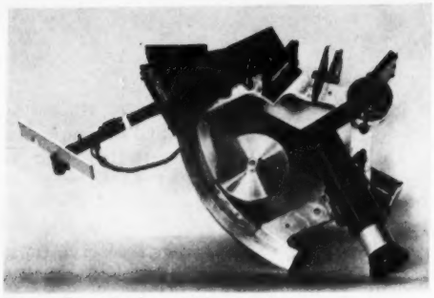


Fig. 1 : Example of a spirit level sextant.

Thirty Years of Celestial Air Navigation[1]

BY ANTOINE BASTIDE, PARIS

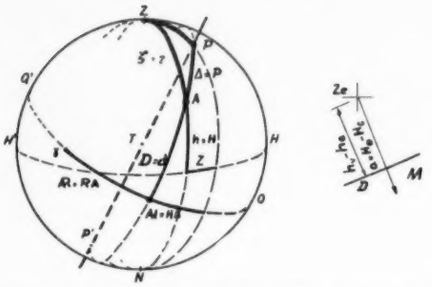


Fig. 2 : Spherical triangle of position (left) and construction of the line of position (explanations in test).

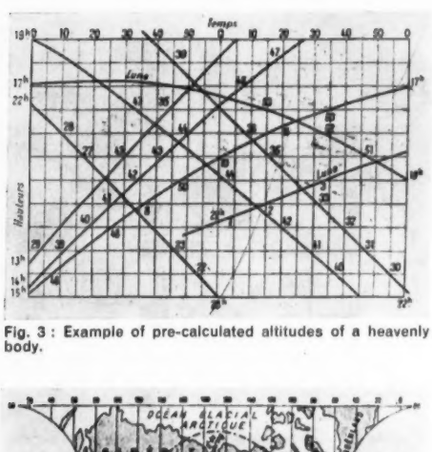


Fig. 3 : Example of pre-calculated altitudes of a heavenly body.

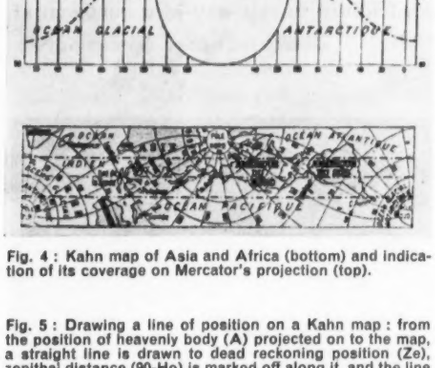


Fig. 4 : Kahn map of Asia and Africa (bottom) and indication of its coverage on Mercator's projection (top).

Fig. 5 : Drawing a line of position on a Kahn map : from the position of heavenly body (A) projected on to the map, a straight line is drawn to dead reckoning position (Ze), zenithal distance (90-Ho) is marked off along it, and the line of position drawn at right angles.

As in marine navigation, there are three methods of determining position in air navigation: landmarks, observation of the stars, and radio-electric transmissions, used either separately or jointly.

But in air navigation it has been necessary to seek new methods and new instruments, since conditions in flight are different. The high speed of aircraft demands rapidity and simplicity in calculations (within about 3 mins.); and instruments must be as light and compact, and as simple to operate, as possible. On the other hand precision need not be as great, again thanks to the high speed (10 nm in air navigation, 1 nm in maritime navigation). As the trip takes only a few hours, calculations can be made in advance and only a limited number of documents and other equipment carried. In short, celestial navigation must be a balanced compromise between speed, simplicity, weight and bulk.

Why has it been necessary to seek this compromise? The rapid development of electronics seemed to encourage the hope that the old method of navigating by the stars would be supplanted and relegated to the past. But this has not been so, and today, even on North Atlantic routes where radar service is complete from one end to the other, celestial navigation is indispensable on 10% of all flights and useful on 60%. On the Azores route it is not 60% but 80% of all flights that can make good use of celestial navigation. Over the South Atlantic, where it is unwise to trust solely to dead reckoning, it is indispensable. Thus celestial navigation continues to be essential, either as sole method or as complementary or supplementary method of navigation.

Sole method — when for example radio aids are inadequate, because of insufficient range of stations, atmospheric disturbances, night effect, or, in wartime, because of the vulnerability of stations, reductions in their service or jamming. In time of war celestial navigation offers aircraft the tremendous advantage of independence of ground services. Also it does not betray its presence, and is a silent and discreet assistant.

*

Celestial air navigation was born about thirty years ago, in the image of marine navigation, copying the latter's manners, but it immediately became extremely audacious, venturing exclusively on the long trips where it was most needed and which were its first field of experiment. This early period was the brief heroic age. It was followed by a period of stimulation, and then by the present period of stabilization.

The heroic period extended from 1922 to roughly 1930. This was the age of the first daring flights across the oceans. Celestial navigation was essential in those days, since the radio organization was distinctly inadequate, and to carry radio equipment in the aircraft often meant a prohibitive increase in load.

The first flight on which celestial navigation was used appears to be *Cabral's* trip from Portugal to Rio de Janeiro in 1922. Cabral was accompanied by Admiral *Coutinho* who had designed a special bubble sextant which could also be used with the sea horizon (cf. *fig. 1*). A bubble sextant was needed because the sea horizon is sometimes invisible and often not clearly recognizable, and because flight at altitude introduces an error due to dip of the horizon.

The methods and equipment used were in general those employed in marine navigation. But calculations are frequently prepared in advance, to correspond to the time-table set (cf. *fig. 3*). There followed a veritable outburst of astronomic methods. Engineers, professors, sailors, airmen, in the countries which were in the lead in aeronautical progress, vied with each other in ingenuity, adapting and perfecting past experience, or getting right away from the beaten track and exploring new ground. Some of the suggestions made got no further than the theoretical stage, others were tried out in practice, with varying degrees of success. The best ultimately passed into common use.

This abundance of new systems naturally came into conflict with the long-standing traditions of maritime celestial navigation and *Marcq Saint Hilaire's* time-honoured method of determining a line of position.

For a clear understanding of what follows it may perhaps be well to recall certain fundamental principles [2] *(fig. 2)* :—

1) To plot a fix by the celestial method the spherical triangle PZA is used, where P is the pole, Z the zenith and A the heavenly body. PZ is the complement of the latitude, or 90° minus φ; PA is the complement of the declination, or 90°-d; ZA is the complement of the altitude of the heavenly body, or 90°-H. Angle P is the angle at the pole; angle Z the azimuth.

2) In practice, to plot a fix is to determine the geographical position of the observer. Preferably if two lines of position can be drawn which intersect, their point of intersection is the exact position of the observer.

How is a line of position obtained? At a given moment the observer assumes himself to be at a dead reckoning position Me *(fig. 2,* where *Me* is marked *Ze)*. He measures the altitude Ho of heavenly body A by means of the sextant, then calculates altitude Hc and azimuth Ze of the heavenly body corresponding to point Me. Next he finds the difference Ho-Hc and then constructs the line of position as follows: from Me he draws a straight line towards the azimuth equal in length to the difference Ho-Hc in the direction of the heavenly body or away from it, as the case may be. Through the point thus obtained he erects a perpendicular to the straight line. This is the line of position. This line is substituted, in the neighbourhood of Me, for an arc of a circle to which it is a tangent. The circle is the geometric position of all points from which heavenly body A is seen at the same altitude above the horizon at the same time. The radius of this small circle is thus equal to the complement of observed altitude Ho.

What was the aim of these experiments? Either to reduce the time taken to calculate Hc and Ze, to eliminate such calculation if possible, or to avoid the second operation which consists of drawing the line of position (or even to avoid both) by using tables or graphs, by some mechanical process, or by a combination of both. The methods examined are not of course concerned with the preparatory calculation of the observed altitude, apparent time or sidereal time. *The following are examples of the proposed improvements :*

[1] Extract from a paper read by the author to the Paris *Académie de Marine.*

[2] Cf. " An Introduction to Celestial Navigation ", in *Interavia* No. 1, 1952, pp. 47-51.

Pre-calculated altitudes: This is the system used in the first place on the long flights. Having fixed on the map the various positions on the route according to the time-table laid down, the altitudes of the sun and moon are calculated in advance for certain positions. These altitudes are then entered as ordinates on graph paper and the times as abscissa. A continuous curve is drawn through the points obtained, giving the curve of pre-calculated altitudes for every moment of the flight *(fig. 3)*. When the navigator makes observations during flight he will compare the altitude observed with the corresponding altitude on the graph and will deduce from this whether or not he is on his correct course; if not he can tell to which side of it he is and how far away.

Tables: The methods which do away with calculations but still require graphic construction of the line of position include a number of systems using tables already in general use in marine navigation, such as *Cornet, Bertin, Ball* or *Gingrich* tables (the two latter are improved versions of *Lecky's* and *Ogura's* tables tried out by American aviators). The principle of these tables is to split the triangle of position into two spherical triangles and to use an auxiliary point, which it is always tiresome to transfer to the map. They necessitate a number of small secondary operations. Their precision varies, from 1′ or less for *Gingrich* to as much as 5′ for *Bertin*. Although limited in the choice of altitudes and declinations, they enjoyed a certain favour. *The tabular method can be used generally.*

Kahn maps: The *Kahn* method is a graphic one; in fact it may even be called a cartographic method. Advantages are that it eliminates calculations and reduces graph drawing to a minimum. It is based entirely on special aeronautical maps (cf. *figs. 4 and 5*) each of which represents a Great Circle course, e.g. China-Japan-Aleutians-California. This Great Circle forms the map's equator. Figures adjoining this equator can be regarded as not distorted. In effect, it is a Mercator's projection in which the enveloping cylinder is a tangent to the sphere at the Great Circle in question. In a band of 15° on either side of the selected equator, Great Circles and rhumb lines are identical. Angles are strictly accurate, and distances largely so. However, such a map can only be used for determining the astronomic fix if the position of the heavenly body measured and that of the observer are both on it. The author has therefore constructed a series of special maps for the astronomic fix, so designed that both heavenly body and observer can always both be found on one or other of them.

It should be noted that all charts showing declinations have to be modified every twelve years for the stars and every two years for the sun.

Weems' altitude curves: This is a graphical method. It is restricted and applies only to certain stars for which graphs have previously been constructed, e.g., Arcturus and Pole Star. Its advantage is that it gives a complete fix. These graphs give the altitudes of the stars as a function of the local sidereal times (abscissa) and latitudes (ordinates). Each sheet deals with two stars. The point of intersection of the respective altitude curves of the two stars observed at the same instant gives the latitude of the position and the local sidereal time which, combined with the sidereal time of the point of origin, gives the longitude. Maximum error is 2.5′. Unfortunately the charts are valid for only six years *(fig. 6)*.

Bastide computer-recorder: This is a mechano-graphical method which does away with calculations and drawing of the line of position. It uses two systems of graphs on transparent bands, one of them relating to a point found by two stars, the other concerning construction of the line of position. In the former case the method is of limited application; in the latter it is suitable for general use. The addition of a transparent geographical chart with Mercator's projection, on the same scale as the graphs, enables the computer to be used as a recorder.

Hagner computer: Mention should also be made of the Hagner computer, which represents the terrestrial sphere by a collection of graduated Great Circlesand

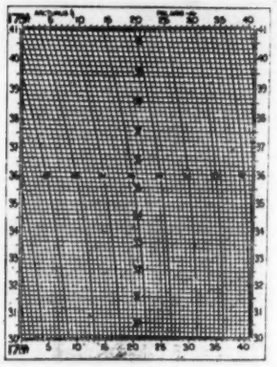


Fig. 6 : Weems' altitude curves for Arcturus (curves) and and the Pole Star (horizontal lines).

articulated planes. This gives the position triangle, and altitude and azimuth are read off on the required graduations.

*

The third period, the period of stabilization, began in 1940, and with it the period of war. When supplies from America were delivered direct by air in large quantities across the Atlantic, and mass squadrons dropped their loads of bombs at great distance, navigation had to be by the stars.

Aircraft had got bigger, and more and more space had been given to the navigator's post, and weight and bulk of celestial navigation equipment no longer had to be quite so restricted. *The proven old system was therefore readopted, in a rejuvenated and modernized form.*

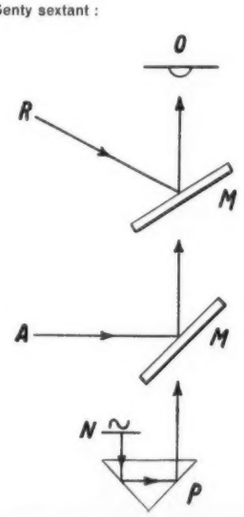
Calculations were done with tables and the line of position drawn as of old. Use was made, as it is today, of American tables H.O.214 or H.O.249, which resemble the French AAF 10 tables, and which eliminate most of the work. The navigator starts in the table with a latitude and declination in round figures and a longitude such that the local hour angle is a whole number of degrees. Altitude and azimuth can be found immediately with a correction rapidly made. The method thus unites speed, simplicity and precision. On the other hand the navigator flying from France to Madagascar has to carry with him a library of a dozen volumes of AAF 10 ! Fundamentally then, it is the increase in the weight of aircraft which has enabled the problem of celestial navigation for aircraft to be solved.

However, two excellent scientific solutions are also worthy of mention, the astrograph and the Genty sextant.

The *astrograph* (a British World War II invention) enables the lines of position of a certain number of heavenly bodies, chosen for a given time, to be projected as a film on a Mercator map. Using the altitude of the heavenly body or bodies observed at the time, the observer thus finds his position on the chart.

The *Genty sextant* (cf. *fig. 7*) gives both altitude and azimuth of a heavenly body. It uses a reference star (R), i.e., the Pole Star in the northern hemisphere and beta in the male hydra in the southern. By means of one optical reflector system (R-M-O) the rays emanating from the reference star provide the vertical plane passing through the reference star and the observer's position; by a second system (A-M-O) the rays from the heavenly body observed give the vertical plane passing through the observed body and the observer's position. When the reflected rays coincide with the luminous rays from the bubble level (N), this joint ray forms the straight line along which the two vertical planes intersect, and the angle between the two planes measures the azimuth of the heavenly body observed in relation to the reference body.

Fig. 7 : Diagram of the Genty sextant :
0 = eye,
R = reference star,
M = mirror,
A = heavenly body observed,
N = bubble level,
P = prism.



*

How has the auxiliary equipment, such as sextants, chronometers and ephemerides, evolved during this same period?

The sextants used in air navigation have long been of the bubble variety. Principal improvements have been made in lighting, enlargement of the field and the addition of a *height-averaging system*. Observation in flight necessitates a number of successive readings of the altitude of a heavenly body, and the average of these altitudes is required for the calculations. In the early days the observer read off each time on the sextant the altitude obtained and on the watch the corresponding time, all of which was time-consuming. Then *automatic height-averagers* were adopted. The *Favé-Lepetit sextant* had a mobile "cylinder and band of paper" device, on which the observer worked after each reading. At the end he obtained a graph from which he extracted the mean value. Some *English and American sextants* automatically mark the altitude every second for two minutes, at the end of which time a shutter closes and obliges the observer to suspend operations; the disadvantage of this system is that the whole process has to be recommenced if for any reason the observer is not able to work consecutively for these two minutes. The *German sextant* remedies this defect; so does the British *Hughes sextant* and the American *Diemal-Black Ball height-averager* fitted to the Kollsman *periscopic sextant* for use in pressurized aircraft.

The problem of the *chronometer* has been greatly simplified by the speed of flight and the frequency of time signals. All that is needed today is a good wrist watch.

Finally, special *ephemerides* have had to be produced for air navigation. This movement began in the United States in 1929, when an "Aviation" supplement was issued to the nautical ephemerides. Improvements were made in particular to the coordinates of the moon, which was recognized as being observable by day as well as the sun, 30 to 40% of the time at low latitudes and 60 to 70% at high altitudes. To avoid interpolations and obtain sufficient accuracy for the arc, Greenwich mean time was entered at intervals of ten minutes. In France the first aeronautical ephemerides were published in 1936. They incorporated important innovations with the object of avoiding interpolations and saving time. Sidereal time is expressed in degrees and minutes of an arc, right ascension is replaced by 360° minus right ascension, to substitute an addition for a subtraction. Civil time is given at intervals of ten minutes. Accuracy of the coordinates is 1′.

*

Regular flying in the Polar regions has once more stressed the importance of celestial navigation, which has become indispensable in these latitudes because of the inadequate radio-electric cover and the absence of landmarks. Special Arctic reconnaissance flights have enabled navigation methods to be refined and adapted to the simplified local conditions. At the Pole, the hour angle of a heavenly body, for example, always corresponds to its azimuth, and the declination to its true altitude. Also both sun and moon can be shot at the same time during the Polar summer.

Additional navigation aids, in particular an *astro compass*, which can take bearings on the sun even in the twilight, have been found to be essential. Finally the American H.O.249 tables, in three volumes, have been generally adopted and the third volume extended to latitude 89°.

Book Reviews

High Speed Aerodynamics and Jet Propulsion — Volume VI, General Theory of High Speed Aerodynamics. — Edited by W. R. Sears. — Published by Princeton University Press, Princeton, New Jersey, 1954. (English, 758 pages, $15.).

High Speed Aerodynamics and Jet Propulsion — Volume IX, Physical Measurements in Gas Dynamics and Combustion. — Edited by R. W. Ladenburg, B. Lewis, R. N. Pearse, H. S. Taylor. — Published by Princeton University Press, Princeton, New Jersey, 1954. (English, 578 pages, $12.50).

*

Though the unimagined evolution of aeronautical research since the beginning of World War II has brought universities, research centres and industry a wealth of technical literature, there have been few comprehensive works covering the larger fields of research. — For this reason a Board of Editors, headed by Professor Theodore von Karman, was formed at Princeton University at the end of 1949 to work out, with Government support, an extensive publishing programme. The result of several years of work has been the twelve-volume " High Speed Aerodynamics and Jet Propulsion " now being published. More than 100 well-known scientists have here collected together basic knowledge of jet propulsion and high speed aerodynamics, discussed the theoretical means of solving these two problems and outlined ways in which future research can most reliably reach the goals it has set itself.

The twelve volumes are devoted to the following aspects of the general subject : I- Thermodynamics and Physics of Matter ; II- Combustion Processes ; III- Fundamentals of Gas Dynamics ; IV- Laminar Flows and Transition to Turbulence ; V- Turbulent Flows and Heat Transfers ; VI- General Theory of High Speed Aerodynamics ; VII- Aerodynamic Components of Aircraft at High Speeds ; VIII- High Speed Problems of Aircraft and Experimental Methods ; IX- Physical Measurements in Gas Dynamics and Combustion ; X- Aerodynamics of Turbines and Compressors ; XI- Design and Performance of Gas Turbine Power Plants ; XII- Jet Propulsion Engines. — A highly comprehensive, but very practical and necessary work.

*

Volume VI collects together present knowledge in the field of high speed aerodynamics and introduces a number of new theories. After an introductory description by Prof. v. Karman of the fundamentals of subsonic, transonic, supersonic and hypersonic flows, K. O. Friedrichs give a new mathematical theory of hyperbolic flows, i.e., unsteady compressible flows. Among subsequent contributions special mention should be made of that by M. A. Heaslet and H. Lomax on supersonic and transonic small perturbation theory, and of that by M. J. Lighthill on higher approximations. This work is so far unique in aeronautical literature. Other sections deal with the theory of potential flow with the aid of the Hodograph method (Y.H. Kuo and W. R. Sears) and two-dimensional and three-dimensional axially symmetric flow (Prof. A. Ferri).

*

Volume IX, to which more than twenty authors have contributed, gives a carefully prepared, instructive survey of measuring methods in fluid flow and combustion research, which provides a good picture of the growing complexity of research installations. — Part 1, entitled " Physical Measurements in Gas Dynamics," describes density, pressure, velocity, temperature, shock front, turbulence, measurements, condensation study and analogue methods. Of the many processes described, those concerned with pressure measurements (interferometry, Schlieren and shadow methods, X-ray technique, spectral absorption and electrical discharge methods), as was to be expected, take up the greatest amount of space. — Part 2 deals with " Physical Measurements in Combustion." It describes flame photography and spectroscopy, as well as flame pressure, temperature and velocity measurements, as essential aids in combustion research. An examination of combustion waves in combustion processes closes this clearly arranged, well illustrated volume. Re.

Massbalancing of Aircraft Control Surfaces. — By H. Templeton. — Published by Chapman & Hall Ltd., London, 1954 (English ; 233 pages, 35 shillings).

Although massbalancing was successfully used long before World War II to damp flutter in control surfaces, this is the first comprehensive book devoted specifically to the subject. — The book is No. 4 in a series of aeronautical monographs published under the authority of the Royal Aeronautical Society, and has been prepared with the assistance of R.Ae.S.'s Aeroelasticity Sub-Committee. — The introductory section sets out the basic problem in readily understandable terms and covers certain kinetic principles. Following a detailed appreciation of historical development since about 1928, an account is given of present methods of massbalancing, chiefly with reference to British work. Finally the author outlines the probable course of future development and the limits of the practical application of massbalancing, with indications of other methods of damping (e.g., combined hydraulic and mechanical damping, irreversible and power-boosted controls, etc.). Details of "non-collinear " systems, flutter problems in trim tabs and brief mathematical treatment of a number of problems are given in an appendix, which forms a valuable supplement. Re.

The Gyroscope Applied. — By K.I.T. Richardson. — Hutchinson's Scientific and Technical Publications, London, New York, 1954. (English, 384 pages, 30 shillings).

It is not so many decades since the gyroscope was known only as a children's toy. How far it has since progressed is described in this book in entertaining though technically instructive form, by a qualified author. The functioning and structure of the various kinds of gyroscope — from the small precision gyro for air navigation to the gyro-stabilizer weighing several tons for ocean-going vessels — are described with examples of their use in the main fields of application, marine, aeronautical and military. The text is profusely illustrated by photographs and drawings provided by manufacturers of the equipment cited. A wealth of concentrated information. Re.

Théorie des Hélicoptères Monorotors, by Jean Ginoux, Free University of Brussels ; published by Office de Publicité S. A., Brussels, 1954 (French, 230 + VIII pages ; 300 Belgian francs).

This book is developed from a series of lectures given by the author to the Aeronautical Institute of the Free University of Brussels, and a reflection of the interest which Belgium shows in the development of helicopters (Belgium was the first country to organize regular passenger helicopter services to neighbouring countries). M. Ginoux here offers his readers a very thorough study of the aerodynamic and mechanical principles underlying flight by single-rotor helicopters. The book, which opens with a comparison between the characteristics of fixed-wing and rotary-wing aircraft, is divided into six chapters covering a description of helicopters in general, hovering flight and vertical climb, vertical descent, the various movements of the blades, level flight, stability and controls of the single-rotor helicopter. The descriptive text is written with great clarity and is supplemented by an advanced mathematical section, the whole being supported by photographs, drawings, graphs and tables which add considerably to the understanding of the subject. A French-English vocabulary, which promises to be of real assistance, is planned as a separate supplement to the book. La.

Books received :

Publications scientifiques et techniques du Ministère de l'Air. Distributed by Service de documentation et d'information technique de l'Aéronautique, Paris.

No. 291. *Etude de la déformation et de la rupture des matières plastiques,* by Félix Zandman.

No. 292. *Contribution à l'étude du mécanisme de la réaction lente entre l'oxygène et une substance gazeuse* (l'exemple de l'Acétaldéhyde), by Michel Niclause.

No. 293. *Etude des textures cristallines obtenues par laminage progressif de monocristaux d'aluminium, by Jack Manenc.*

ICAO (English, French, Spanish) :

Division de météorologie ; Rapport de la quatrième session (Montreal, June 15th to July 14th 1954). — Doc. 7520-MET/525.

Photo credits : Front cover : Interavia ; pp.88–89 : author ; pp.90–97 : S.A.S. (5), Interavia (40) ; pp. 98–102 : Service Américain d'Information, Paris (3), Service d'Information de l'U.R.S.S., Paris (4), ATP (1), Interavia (2) ; pp. 107–109 : author (5), Agence Intercontinentale AFP, Paris (2), Expéditions Polaires Françaises (1), Norges Svalbard og Ishavsundersøkelser, Oslo (1) ; pp. 110–111 : author ; pp. 112-115 : S.A.S. (4), manufacturers (3), Interavia records (3) ; pp. 116–117 : author ; pp. 118–119 : Directorate of Public Works, Canton of Zurich ; p. 116 : manufacturers ; pp. 121–122 : Iberia (1), manufacturers (5) ; p. 123 : Interavia records ; pp. 124–125 : manufacturers ; pp. 126–127 : author.

PIONEER

Parachute Company

•

Specialists in Special Purpose Parachutes

The continual development and new uses for parachutes is one of the great achievements of the aviation industry.

The Pioneer Parachute Company has always worked closely with leading aviation engineers in the armed forces and aircraft companies. Our tremendous experience and facilities for designing, testing and manufacturing special purpose parachutes have given us the rating of authorities and specialists in this field, and we accept this additional recognition as a public trust.

Our service and sales engineers are available for "on-the-spot" consultation.

Parachutes Make The Difference!

PIONEER PARACHUTE COMPANY, INC.

MANCHESTER, CONN., U. S. A. *Cable Address PIPAR*

In Canada: PIONEER PARACHUTE COMPANY OF CANADA, LTD., *Smiths Falls, Ontario*

Holland & Denmark: Schreiner & Company, 20 a Buitenhof, Den Haag, Holland
Switzerland: Riwosa S. A., Witikonerstrasse 80, Zurich 32, Switzerland
Turkey: Mr. Affan Ataceri, 69 Adakale Sokak, Yenisehir, Ankara, Turkey
Belgium: Benelair, Ltd., Rue Royale 43, Brussels, Belgium
Norway: Wideroe's Flyveselskap A. S., Kr. Augustsgt. 19, Oslo, Norway
France: Mr. Guy Robert, Equipements d'Aérodromes & d'Avions, 11, Rue Tronchet, Paris 8, France
Sweden & Finland: Mr. Ake Forsmark, Kummelvagen 9, Alsten, Stockholm, Sweden

The Mind of Mr. Reader

Aircraft development in China

Dear Sir,

I enclose cutting about China's first aeroplane (stating that it flew on June 26th, 1954). I was surprised your journal has not mentioned it. Perhaps you could give more details, i.e., whether piston or jet ; designed by Chinese or Russian technicians and designers or both ; where it was built—possible future of aero-industry in China. Unless, of course, you follow the prevalent mode in some quarters, off calling Formosa China. Incidentally, the editorial of No. 1, 1954, p. 15, made the following mention : " But new tensions are on the horizon. They are of an economic variety and cannot fail to affect the growing strength of civil and military aviation. Whereas at the end of 1952 there were only three powers with large-scale production—the United States, Britain and Russia—1953 has shown that the Continental European aircraft industry is also awakening, that *India and China*, Japan, Australia and others are beginning to think about manufacturing aircraft." You did not mention the effect of automatization which has already started in the American, partly in the British and possibly in the Russian aircraft industries. An American professor visiting Britain claimed on our television that they had jet engines made without being touched by human hands. Anyway, the beginning of the aircraft industry in China—the most populous nation in the world—700 millions of industrious people—irrespective of regime—is surely a major event.

Loughborough, Leicester. W. R. Bentham

As previously explained in these columns, Interavia cannot be blamed for seemingly neglecting the doubtless interesting development of aviation behind the Iron or the Bamboo Curtains. The absence of authentic details and the editors' principle not to publish information that cannot be vouched for, enforce a certain reserve.—An article on automatic production in the United States—at any rate in the electronic field— was published in No. 12, 1954.

Flying saucers...

Dear Sir,

I have been an ardent reader of your magazine for many years and have always found your articles to be objective. For this reason I should like to ask you to devote an article to the so-called " flying saucers ". Just publish what you consider to be the truth or the most probable explanation of these flying objects... One of our Hungarian magazines, " Béke és Szabadság " (" Peace and Freedom ") wrote on the subject in October 1954 ... And our daily " Szabad Nép " (" Free People ") has reported on the West's " flying saucer fever ". In September 1954 Salzburg radio devoted considerable time to these phenomena.

Szombathely, Hungary. Németh Tibor, Dipl. Ing.

The editors must unfortunately disappoint Mr. Németh. They know of no documents on flying saucers which would stand critical examination. Even the analysis of all existing material in "Forces Aériennes Françaises" comes to the conclusion that nothing has so far been proved.

Model aircraft from Interavia pictures

Dear Sir,

I have bought your very interesting aviation magazine every month since 1949 and have taken out a subscription for this year. I should like to thank you for producing this Review, which gives both layman and expert precise information on all aircraft types, whether commercial or military.

With the aid of technical descriptions, three-view drawings and dimensions published in your Review, I have built several model aircraft, pictures of which I am enclosing. I am a great aviation fan, and model building is my favourite pastime.

Cully, Vaud. J. P. Béguelin

By

ALITALIA

DC-6B

with pressurized, sound-proofed, air-conditioned cabin

Cruising speed 320 m. p. h.

Lounge chairs

Sleepers

From ROME to BUENOS AIRES

via Lisbon-Rio de Janeiro-Sao Paulo in 28 FLYING HOURS

Information and reservations from your own travel agency or from :

ALITALIA

ROME : 15, Via L. Bissolati Tel. 470.242

MILAN : 6, Via G. Verdi Tel. 877.107

SOURIAU AVIATION

PLUGS AND SOCKETS to FRENCH BRITISH AMERICAN STANDARDS

Catalogues on request

CATALOGUES SUR DEMANDE

SOURIAU & Cie

SOCIÉTÉ ANONYME AU CAPITAL DE 100.000.000 DE FRANCS

9 à 13, RUE DU GÉNÉRAL GALLIÉNI

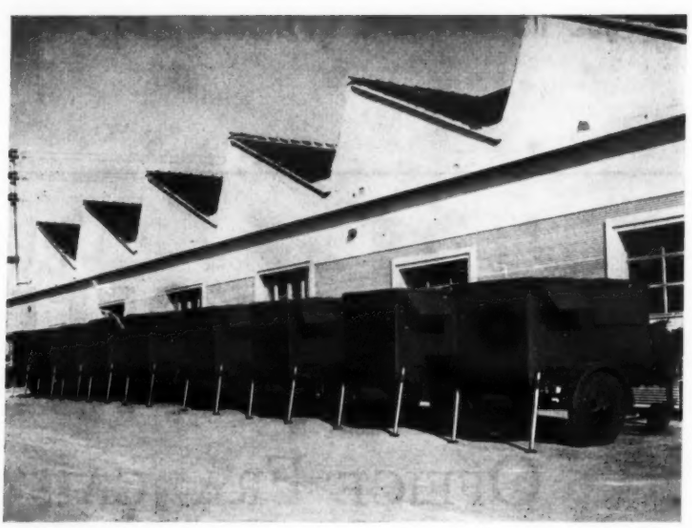
BILLANCOURT (SEINE)

TÉL. : MOLitor 67-20

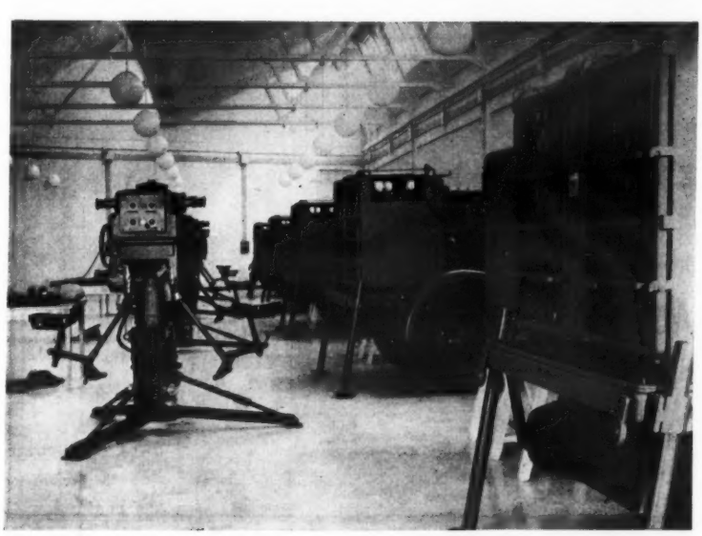
CONTRAVES ITALIANA

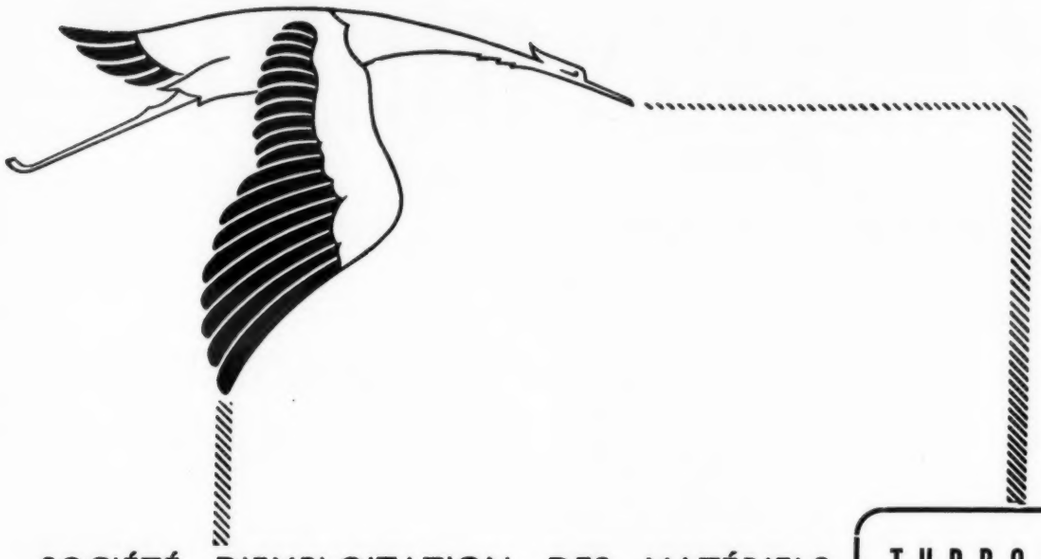
F90 COMPUTER
T90 TRACKER

for A. A. 90 mm. batteries



CONTRAVES ITALIANA S. p. A.
ROMA
LUNGOTEVERE DELLE ARMI 12





SOCIÉTÉ D'EXPLOITATION DES MATÉRIELS

HISPANO SUIZA

RUE DU CAPITAINE GUYNEMER - BOIS-COLOMBES - SEINE

TURBOJETS
AIRCRAFT ENGINES
DIESEL ENGINES
ALUMINIUM FOUNDRY

OFEMA

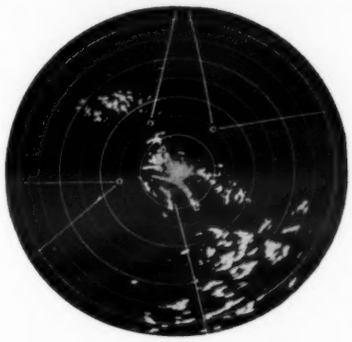
OFFICE FRANÇAIS D'EXPORTATION DE MATÉRIEL AÉRONAUTIQUE

4, rue Galilée PARIS XVI[e] Telephone : KLEber 89-10

Sales office

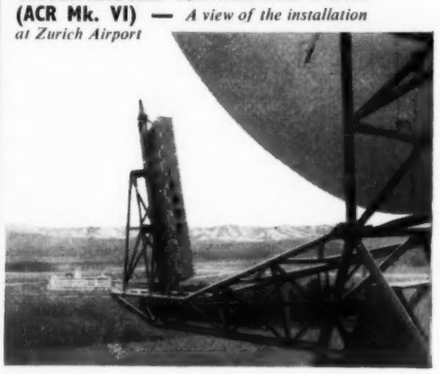
for the exportation of the French aircraft industry's products

COSSOR ENGINEERS MOVE THE ALPS



These two 40-mile range PPI photographs were taken on the Cossor Airfield Control Radar Mk. VI now installed at Zurich, Switzerland. That on the left is the normal radar display. The other PPI (right) shows clearly the effectiveness of the Cossor developed PERMANENT ECHO CANCELLATION circuits; the moving aircraft responses previously obscured are now revealed. Mountainous terrain such as is found in Switzerland, with saturation ground returns, has hitherto been a nightmare for radar operators. Cossor engineers specialize in advanced development of this kind and have produced
THE FINEST CONTROL RADAR—ACR MK. VI BY COSSOR.

COSSOR AIRFIELD SURVEILLANCE RADAR (ACR Mk. VI) — *A view of the installation at Zurich Airport*



COSSOR

PERMANENT ECHO CANCELLATION
C.R.D.F. SUPERIMPOSITION
60 MILES RANGE
VIDEO MAPPING

THE COSSOR GROUP OF COMPANIES · HIGHBURY GROVE · LONDON · N.5

A. C. COSSOR LIMITED — STERLING CABLE CO. LTD. — COSSOR RADAR LTD.
BEST PRODUCTS LTD. — COSSOR (CANADA) LTD. — BEAM INSTRUMENTS CORPORATION (U.S.A.)

CR.57

AVIONS LOUIS BREGUET

SERVICES LINKING

4 continents

ASIA
EUROPE
AFRICA
U. S. A.

AUSTRIA — EGYPT — FRANCE — GERMANY
GREECE — IRAN — IRELAND — ISRAEL — SPAIN
SWITZERLAND — TUNISIA — TURKEY
UNITED STATES
connected with the whole Italian network
by DOUGLAS DC-6B
and CONVAIR LINER

LAI

LINEE AEREE ITALIANE
in Switzerland : SWISSAIR

Wanted exclusive sales rights
for aircraft
and aeronautical equipment

INTRACO
G. m. b. H.

MUNICH 15 · Landwehrstrasse 3
Telephone 55 4 77
Teleprinter 052/3310

INTERAVIA Review of World Aviation - Volume IX, 1954

Bindings
with gilt lettering
available now

Price: Switzerland SFr. 10,–
Abroad SFr. 11,–
Including postage and packing

INTERAVIA S.A. Geneva 11, Switzerland

POTEZ 75

GROUND SUPPORT AIRCRAFT
450 H. P. POTEZ 8 D ENGINE

SOCIÉTÉ DES AVIONS ET MOTEURS HENRY POTEZ
Kléber 27-83 46, avenue Kléber, PARIS XVI[e] POTEZAERO-PARIS

Printed in Switzerland

FIAT AVIATION

aircraft, engines, propellers

FIAT G 82

Max. speed 580 m.p.h.
Range 840 miles
Service ceiling 42,650 ft.

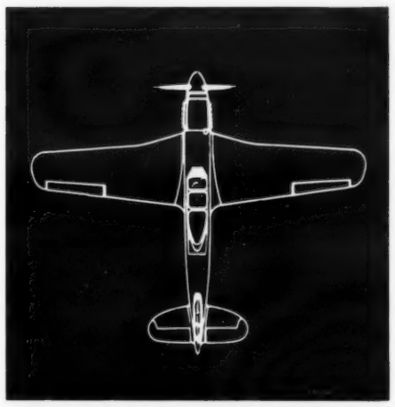
FIAT G 80-3B

Max. speed 520 m.p.h.
Range 685 miles
Service ceiling 37,700 ft.

Fiat's series of trainers

FIAT G 80-1B

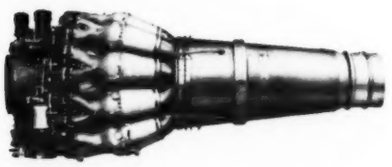
Max. speed 530 m.p.h.
Range 620 miles
Service ceiling 39,400 ft.



FIAT G 59-4B

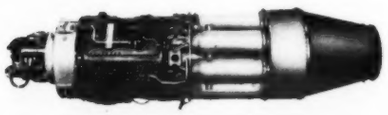
Max. speed 370 m.p.h.
Range 525 miles
Service ceiling 39,700 ft.

Turbojets



FIAT GHOST 48 MK 1

D. H. licence

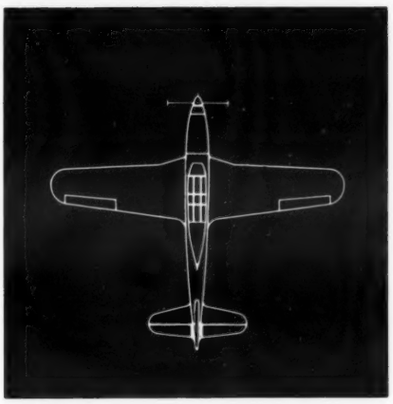


FIAT ALLISON J35-A29

(parts)
Allison licence

FIAT G 49-2

Max. speed 230 m.p.h.
Range 1,070 miles
Service ceiling 24,000 ft.

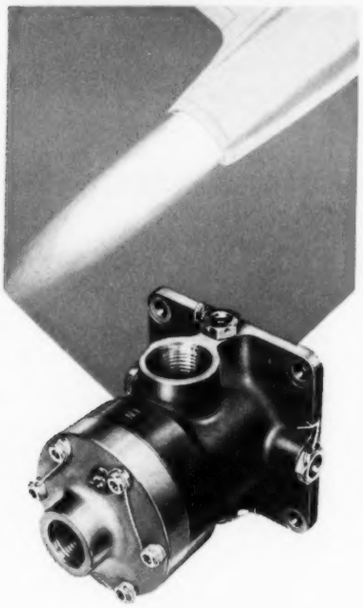


FIAT G 46-4B

Max. speed 193 m.p.h.
Range 580 miles
Service ceiling 17,700 ft.

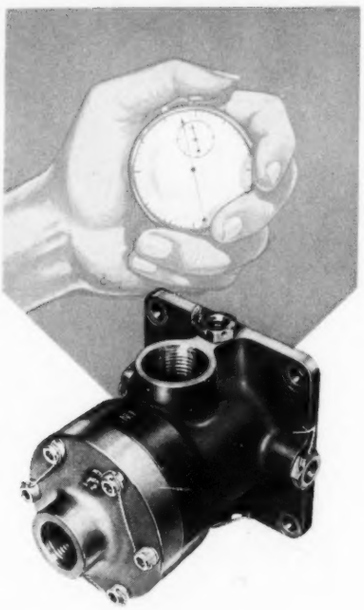
FIAT DIVISIONE AVIAZIONE — CORSO GIOVANNI AGNELLI 200 **TURIN** (Italy)

FOR HIGHER TEMPERATURES



FOR HIGHER CEILINGS

FOR HIGHER SPEEDS



The New Series 66 Fixed Displacement STRATOPOWER HYDRAULIC PUMPS

Design for tomorrow's aircraft...that's the keynote of the new series of STRATOPOWER Hydraulic Pumps. The 66 Series Fixed Displacement Pumps deliver fluid power continuously from sea level to extreme altitudes, permit increased drive speeds and raise the temperature limits of operation—and they raise performance standards of today's planes to new highs in reliability and efficiency.

STRATOPOWER 66 Series Pumps pack more power than ever into extremely small dimensions. They feature a piston actuation mechanism which is positive in action, unaffected by fluid temperatures or inlet pressures...a mechanism which transmits power by means of fewer moving parts and with exceptionally high efficiency at all speeds. These Pumps are designed to meet or surpass the requirements of specification MIL-P-7858. The new 66 Series Pumps have exceedingly high fluid-horsepower/weight ratios. Their low weight will be of prime interest to aircraft designers.

The significant facts about the new Series 66 are important information for every aircraft hydraulic engineer. A STRATOPOWER engineer will gladly give you the facts.

Write for full information on the 66 Series STRATOPOWER Pumps and other new STRATOPOWER developments.

WATERTOWN DIVISION
THE NEW YORK AIR BRAKE COMPANY
STARBUCK AVENUE • WATERTOWN • N. Y.

WATERTOWN DIVISION
The New York Air Brake Co.
710 Starbuck Ave., Watertown, N. Y.

I would like full information on the NEW 66 Series STRATOPOWER Fixed Displacement Hydraulic Pumps.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____